No. 13. Vol. 5.
(New Series. No. 9. Vol. I.)

SIXPENCE.
(Registered as a Newspaper.)

FRIDAY,
DECEMBER 9, 1904.

PAGE'S WEEKLY

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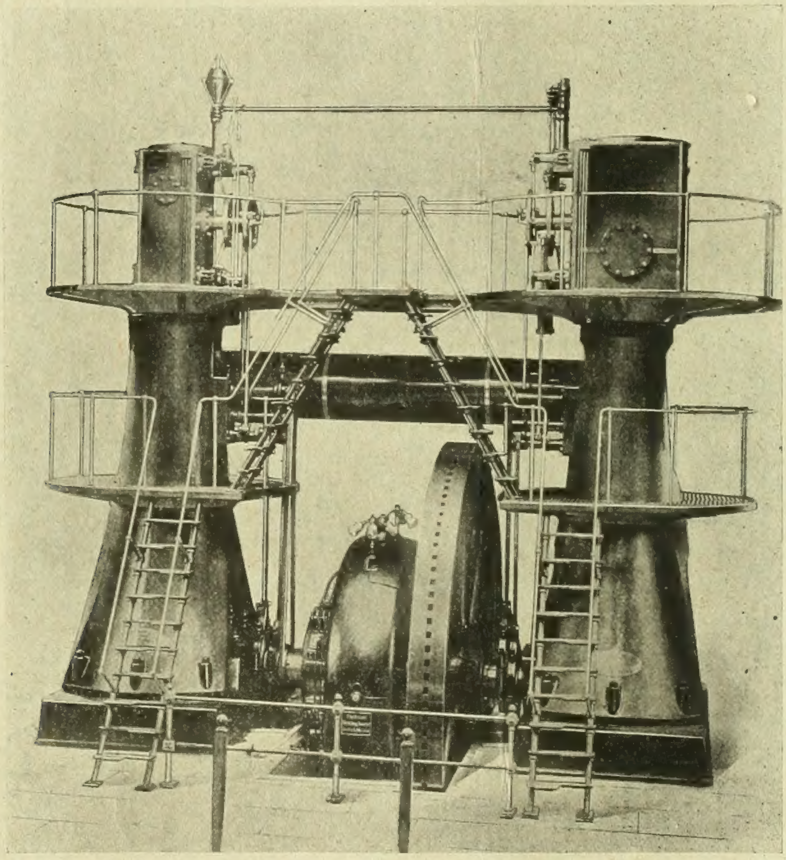

The Engine cost £2,450. **The Separator cost £1,300.**

LIST OF LEADING DIMENSIONS OF 18 in. x 36 in. x 42 in. VERTICAL CROSS COMPOUND CORLISS ENGINE.

H.P. Cylinder, diameter	**18** in.
L.P. " "	**36** in.
Stroke of Cylinders	**42** in.
Steam Inlet, diameter	**6** in.
Exhaust Outlet, diameter	**13** in.
Main Bearings, diameter	**14** in.
Main Bearings, length	**24** in.
Piston rod, diameter	**3½** in.
Crosshead Pin, diameter and length	**6½** in. by **6½** in.
Crank Pin, diameter and length	**7** in. by **7** in.
Bore of Crosshead Guide	**24** in.

GENERATOR.—300 kw Direct Current, Shunt Wound, Engine Type Westinghouse Generator, **500** volts, **8** poles, at **90** revolutions per minute or will do **265** kw at **440** volts at **90** revolutions per minute.

FOR IMMEDIATE SALE AT A VERY REASONABLE FIGURE.

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PAGE'S WEEKLY Miscellaneous

Mr. G. H. HUGHES, M.I.Mech.E.,
Consulting and Organising Engineer for Water Works and Industrial Undertakings,
97, QUEEN VICTORIA ST., LONDON, E.C.
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ED. BRAND, *MECHANICAL ENGINEER.* 35, SHAKESPEARE STREET, MANCHESTER.
Modern Wire-Working Machinery,
Such as for Rolling, Drawing, Weaving, Netting, Forming, Automatic Straightening and Cutting, Cabling, Testing, &c.
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Rolled Steel Joists, Channels, etc.
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Heating Apparatus
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Equal in STRENGTH to, and MORE DURABLE than Cast Iron, Gun Metal, or Rawhide.
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Have stood test of four years.
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PAGE & ROWLINGSON,
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Mr. PAGE, who is a Whitworth Exhibitioner and an Associate Member of the Institute of Civil Engineers, has had a large experience as a Practical Mechanical Engineer, and is specially qualified to deal with the most intricate mechanical problems successfully. *Write for Handbook of Information Free.*
28, NEW BRIDGE STREET, LONDON, E.C.,
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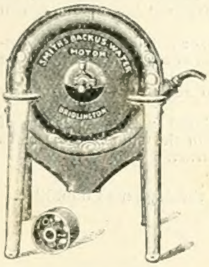

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Will drive any class of Machinery, and work on 15 lb. pressure.
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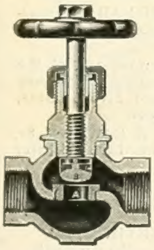
The "SHAW" Patent Steam Valves . .



With Renewable Seats, Interchangeable Concentric Valve, Compound Packing to Spindle, Special Metal, and High-Class Workmanship.
The "SHAW" Patent Parallel Slide Valve is the Acme of Simplicity and Durability.
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RECORDERS, LTD., 171, Queen Victoria Street, LONDON, E.C.

PAGE'S WEEKLY Contracts

CONTRACTS.

ASYLUMS COMMITTEE OF LONDON COUNTY COUNCIL.

The Asylums Committee of the London County Council are prepared to receive TENDERS for the INSTALLATION of HEATING, VENTILATING, and HOT-WATER PLANT at the Long Grove, Asylum, Epsom, Surrey, now in course of erection.

Instructions for Tender and forms of Tender and Contract, with specification and schedules thereto annexed, together with plans and cover, can be obtained from the Clerk of the Committee, No. 6, Waterloo Place, London, S.W., on or after Thursday, the 1st December proximo, on payment of a deposit of £5 for each copy. The amount deposited will, after the Committee have come to a decision upon the Tenders received, but not before, be returned to the tenderer, provided he shall have sent in a *bonâ fide* Tender and shall not have withdrawn the same.

Tenders must be on the printed form, and must be accompanied by the form of contract and schedules thereto and bond.

The Tender and accompanying documents, completed in accordance with the instructions, must be enclosed in the authorised sealed cover, endorsed "Tender for Heating, Long Grove Asylum," and be delivered at the Office of the Committee, 6, Waterloo Place, London, S.W., on or before Monday, the 23rd January, 1905, after which no Tender will be received.

Any Tender not made on the printed form, or not filled up and complete in every particular in accordance with the instructions, will be rejected.

The Committee do not bind themselves to accept the lowest or any Tender.

The contractor will have to enter into a bond in the penal sum of £2,000, with two approved sureties, each in the sum of £1,000, as security for the due performance of the contract.

R. W. PARTRIDGE,
Clerk of the Asylums Committee.

Asylums Committee Office,
6, Waterloo Place, London, S.W.,
November 16th, 1904.

JOHANNESBURG MUNICIPALITY.

The Municipal Council of Johannesburg is prepared to receive

TENDERS FOR :—

TRANSFORMER PILLARS and SWITCHGEAR to Specification No. 8, of their Consulting Engineers, Messrs. Mordey and Dawbarn, 82, Victoria Street, London, S.W.

Copies may be seen on and after Saturday, November 5th, at the Council Offices, Johannesburg, and at the Consulting Engineers' Offices in London, and may be obtained on payment of Five Guineas, which will be returned on receipt of a *bonâ fide* Tender.

Tenders must be addressed to Messrs. Mordey & Dawbarn, 82, Victoria Street, Westminster, S.W., and received by them not later than Tuesday, December 27th, 1904.

The lowest or any Tender will not necessarily be accepted, and the Council will not be responsible for any expenses incurred in Tendering.

R. FEETHAM,
Town Clerk.

Johannesburg.

WATERWORKS OF CRAIOVA (ROUMANIA).

The Town Administration invite

TENDERS FOR :—

Contract No. 5.

About 27,850 metre MAIN CAST-IRON ADDUCTION PIPE, 500 mm. diam., and 5,925 metre MAIN PRESSURE PIPE, 300 mm. diam. Contract to comprise Excavations, complete Laying and Caulking of Pipes, Fixing of Fittings, of the Manholes, Crossings, Outlets, Sheet Pilings, and all Accessory Work.

Further information may be obtained from the "Bureau de l'approvisionnement d'Eau," in Craiova, Strada Solomon 5, whence Specifications of Contract and official Forms of Tenders may be had in the Roumanian or German language, on payment of Five Lei.

All Tenders to be sent on the Official Forms, accompanied by the prescribed guarantee, post paid, sealed, addressed to "Le Maire de la Ville de Craiova (Roumania), N. P. Romanescue," at or before Eleven a.m., the 16th to 29th December, 1904, at which hour they will be opened in the presence of such of the Tenderers or their Representatives as may be present.

The Tenderer remains bound to his Tender up to the 16th February to 1st March, 1905.

Le Maire de la Ville de Craiova,
G. N. PESSICU.

Craiova, October 12th, 1904.

METROPOLITAN BOROUGH OF FULHAM,

ELECTRICITY DEPARTMENT.
Contract "K."

The Council is prepard to receive

TENDERS FOR THE SUPPLY AND ERECTION of a 3,000 volt STEAM ALTERNATOR of 1,000 kw. capacity, coupled to Bellis Engine, at their Generating Station, Townmead Road, Fulham.

Specifications and Forms of Tender may be obtained from the Borough Electrical and Consulting Engineer, Mr. A. J. Fuller, after the 5th instant, on payment of a deposit of One Guinea, which will be returned on receipt of a *bonâ fide* Tender.

Tenders made out on Form supplied, addressed to the Town Clerk, Town Hall, Fulham, and endorsed "Tender for Contract K," to be delivered at the Town Hall not later than Twelve noon, on Tuesday, the 20th instant, 1904.

The lowest or any Tender not necessarily accepted.

By Order,
R. M. PRESCOTT,
Town Clerk.

Town Hall, Fulham,
December 1st, 1904.

MANCHESTER SHIP CANAL.

DOCK No. 9.
ELECTRIC POWER AND LIGHTING.

Contract "C."

The Directors of the Manchester Ship Canal Company are prepared to receive

TENDERS FOR THE SWITCHBOARDS, MAINS, FEEDERS, &c., for the Supply of Electric Current for power and lighting, and for ARC LAMPS, &c., in connection with the new Dock Works in the County Borough of Salford.

Contract "D."

The Directors of the MANCHESTER DOCK AND WAREHOUSE EXTENSIONS COMPANY, Ltd., are prepared to receive TENDERS for the MAINS, FEEDERS, &c., for the supply of Electric Current for power and lighting, and for ARC LAMPS, &c., in connection with the new Dock Works in the County Borough of Salford.

The Drawings for both Contracts can be inspected, and copies of the Specifications, Bills of Quantities, and Forms of Tender can be obtained at the office of Mr. W. H. Hunter, M.Inst.C.E., Chief Engineer to the Manchester Ship Canal Company, 41, Spring Gardens, Manchester, on and after Monday, the 5th instant, on payment of a sum of Three Guineas, which will be returned on receipt of a *bonâ fide* Tender.

Sealed Tenders, addressed to the undersigned, and endorsed respectively "Tender for Contract C," and "Tender for Contract D," should be delivered at this Office at or before Ten a.m on Thursday, the 22nd December, 1904.

F. A. EYRE, Secretary,
Manchester Ship Canal Company.

41, Spring Gardens, Manchester,
December 1st, 1904.

EAST INDIAN RAILWAY.

The East Indian Railway Company is prepared to receive

TENDERS FOR THE SUPPLY AND DELIVERY OF :—

(1) SPIRAL and VOLUTE SPRINGS,
(2) 150 ft. DECK SPANS for Tonse Bridge,

as per Specifications to be seen at the Company's Offices.

Tenders are to be sent to the undersigned not later than Twelve o'clock Noon, marked "Tender for Spiral, &c., Springs," or, as the case may be, for No. 1 on Wednesday, the 14th day of December instant, and for No. 2 on Wednesday, the 21st of December instant.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By Order,
C. W. YOUNG,
Secretary.

Nicholas Lane, London, E.C.,
December 1st, 1904.

TO BOILERMAKERS.—NEW LANCASHIRE STEAM BOILER.

CHELSEA INFIRMARY.—THE GUARDIANS of the POOR, Chelsea, invite TENDERS for the SUPPLY of a first-class new STEEL LANCASHIRE BOILER, 26ft. long by 7ft. diameter, constructed for a working steam pressure of 100 lbs.

Specification and Form of Tender will be supplied upon written application to me, at the Guardians Offices, 250, King's Road, Chelsea.

By order,
JOSHUA DOWLING,
Clerk to the Guardians.

1st December, 1904.

PAGE'S WEEKLY Contracts

COUNTY BOROUGH OF CARDIFF.

TO MAKERS OF PUMPING MACHINERY, STEAM BOILERS, AND GAS ENGINES.

The Corporation of the County Borough of Cardiff hereby invite competitive **DESIGNS** and **TENDERS** (from manufacturers of repute only in the particular class of work tendered for) for the **SUPPLY, DELIVERY, and ERECTION of PUMPING MACHINERY and PLANT** required in connection with the proposed Western District Main Outfall Sewer as follows:—

CONTRACT No 1.—For combined Sewage Pumping Engines and Pumps of a maximum capacity of 700,000 gallons per hour.

CONTRACT No. 2.—For the Steam Generating Plant required for Contract No. 1.

CONTRACT No. 3.—For two **Sets of Gas Engines and Centrifugal Storm-water Pumps**, each capable of discharging 680,000 gallons per hour.

Drawings and provisional specification may be seen and full particulars as to the contemplated works may be obtained at the office of Mr. W. HARPUR, M.Inst.C.E., the Borough Engineer, Town Hall, Cardiff, on and after Monday November 7th, and copies of the drawings and specification, with forms of Tender, will be supplied on receipt of a deposit of **Five Guineas**, which deposit will be returned on receipt of a *bonâ fide* Tender.

Tenders, sealed and endorsed "Tenders for Pumping Machinery," to be delivered at my office on or before Wednesday, December 21st.

The Corporation does not bind itself to accept the lowest or any Tender, and will not be liable for or defray any costs incurred in the preparation of any Designs and Tenders.

Town Hall, Cardiff, J. L. WHEATLEY, Town Clerk.
October 31st, 1904.

BOROUGH OF CHIPPENHAM URBAN DISTRICT COUNCIL.

WORKS OF SEWERAGE AND SEWAGE DISPOSAL.

The Chippenham Urban District Council are prepared to receive **TENDERS** for the following **NEW SEWERS**, with **MANHOLES, FLUSHING CHAMBERS**, and other works connected therewith:—

About 850	yards of	9 in. diam.	Pipe Sewers.
2280	,,	12 in.	,,
627	,,	15 in.	,,
564	,,	18 in.	,,
848	,,	21 in.	,,

The building of Detritus and Screening Tanks, Liquifying Tanks, Contact Filter Beds, Low-level Collecting Tank, Percolating Storm Filter, Engine and Pump House. The fixing of all Machinery, Valves, Pipes, &c.

Conditions, specification, quantities, and form of Tender may be obtained from the Engineer, Mr. A. E. ADAMS, A.M.I.M.E., High Street, Chippenham, Wilts, on payment of the sum of £2 2s., which will be returned on the receipt of a *bonâ fide* Tender and of the conditions, specification, and priced quantities.

The drawings may be seen at the Engineer's Office.

Sealed Tenders, upon the form supplied, to be sent in addressed to the Town Clerk, Chippenham, Wilts, not later than Ten o'clock in the morning of Tuesday, the thirteenth day of December, 1904, and endorsed "Tender for Chippenham Main Drainage, &c."

The Council do not bind themselves to accept the lowest or any Tender.

FRANCIS H. PHILLIPS, Town Clerk.

Chippenham, Wilts.
November, 1904.

THE SOUTH INDIAN RAILWAY COMPANY, LIMITED,
is prepared to receive

TENDERS FOR THE SUPPLY OF:—

(1) **GENERAL STORES**: Comprising Hardware, Iron, Steel Metals, Oils and Colours, Leather, Rubber, and Sundries.
(2) **LOCOMOTIVE STORES**: Comprising Cranks, Copper and Steel Plates, Tyres, Axles, Springs, and Trollies.
(3) **STATIONERY**: Comprising Books, Paper, Envelopes, Ink, and Sundries
(4) **ROOFING**: Five Spans of 100 ft. by 25 ft.
(5) **FENCING**: About 60 tons.

Specifications and Forms of Tender may be obtained at the Company's Offices.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Co., Limited, marked "Tender for General Stores," or as the case may be, must be left with the undersigned not later than Twelve o'clok noon of Tuesday, the 13th December, 1904.

The Company is not bound to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 20s. for each copy of Specification No. 1, and of 10s. for each copy of Nos. 2, 3, 4, and 5.

Copies of the Drawings may be obtained at the Office of Sir GEORGE B. BRUCE, 3, Victoria Street, Westminster, on payment of 5s. per sheet.

By order, HENRY W. NOTMAN,
Managing Director.

Company's Offices,
55, Gracechurch Street, London, E.C.,
November 25th, 1904.

JOHANNESBURG MUNICIPALITY.
The Municipal Council of Johannesburg is prepared to receive

TENDERS FOR

TWO 35 ton ELECTRIC OVERHEAD TRAVELLING CRANES

to Specification No. 9 of their Consulting Engineers, Messrs. MORDEY AND DAWBARN, 82, Victoria Street, London, S.W.

Copies may be seen on and after Saturday, November 5th, at the Council Offices, Johannesburg and at the Consulting Engineers' Offices in London, and may be obtained on payment of Five Guineas, which will be returned on receipt of a *bona fide* Tender.

Tenders must be addressed to Messrs. MORDEY AND DAWBARN, 82, Victoria Street, Westminster, S.W., and received by them not later than Tuesday, December 27th, 1904.

The lowest or any Tender will not necessarily be accepted, and the Council will not be responsible for any expenses incurred in Tendering.

R. FEETHAM,
Johannesburg. Town Clerk.

WELWYN RURAL DISTRICT COUNCIL.

WELWYN SEWAGE DISPOSAL.

CONTRACT No. 2.

TO OIL ENGINE AND PUMP MAKERS.

The above-named Council are prepared to receive **TENDERS** for the **SUPPLY, DELIVERY, ERECTING**, and **SETTING** to **WORK** of **TWO OIL ENGINES** and **TWO TREBLE-RAM PUMPS**, together with other Machinery, Fittings, Pipes, Tools, &c., in the Parish of Welwyn, Hertfordshire.

Specifications may be obtained from the office of the Engineers, Messrs. HERBERT WALKER and SON, Assoc. M.M.Inst.C.E., Albion Chambers, King Street, Nottingham, on payment of Two Guineas, which will be returned on receipt of a *bona fide* Tender.

Sealed Tenders, on the form supplied, and accompanied by the contractor's full detailed specification and drawings, and endorsed "Welwyn Sewage Disposal.—Contract No. 2," to be delivered to me on or before Monday, the 19th day of December, 1904.

The Tenders will be opened at the meeting of the Council to be held at the Board-room, Union Workhouse, Welwyn, on Wednesday, the 21st day of December, 1904, at 10.30 a.m.

The lowest or any Tender will not necessarily be accepted.

By order of the Council,
Council Offices, THOMAS J. SWORDER,
November 22nd, 1904. Clerk.

COUNTY OF LONDON.—THE LONDON COUNTY COUNCIL TRAMWAYS.

TO ENGINEERS AND OTHERS.

The London County Council invites **TENDERS** for the **MANUFACTURE, SUPPLY, DELIVERY**, and **ERECTION** of **SEVEN CAST IRON WATER TANKS**, &c., required for use at the Council's electricity generating station at Greenwich.

The tanks are to be of the following dimensions: One tank, 45 ft. 9 in. by 30 ft. 9 in. by 6 ft., internal dimensions; two tanks, 45 ft. 9 in. by 12 ft. 9 in. by 6 ft., internal dimensions; and four tanks, 15 ft. 9 in. by 9 ft. 9 in. by 6 ft., internal dimensions.

Persons desiring to submit Tenders may obtain the drawings, specification, form of Tender, &c., at the County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council of the sum of Two Pounds. This amount will, after the Council or its Committee have come to a decision upon the Tenders received, but not before, be returned to the tenderer, provided he shall have sent in a *bona fide* Tender and not have withdrawn the same, but in no case will the fee be returned unless a *bona fide* Tender is submitted.

Full particulars of the work may be obtained on application at the County Hall, previously to the payment of the fee for the specification, &c.

Tenders must be upon the official forms, and the printed instructions contained therein must be strictly complied with.

The contractors will be bound by the contract to pay to all workmen (except a reasonable number of legally bound apprentices) employed by them wages at rates not less and to observe hours of labour not greater than the rates and hours set out in the Council's list, and such rates of wages and hours of labour will be inserted in and form part of the contract by way of schedule.

Each Tender is to be delivered at the County Hall, in a sealed cover, addressed to the Clerk of the London Council, Spring Gardens, S.W., and marked "Tender for Water Tanks, L.C.C. Tramways."

No Tender will be received after 10 o'clock a.m. on Tuesday, the 13th day of December, 1904.

Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender, and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened, unless the reasons for the withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.
County Hall, Spring Gardens, S.W.

BUYERS' DIRECTORY.

Note.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages* 23 and 25.

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. *for each additional section.*

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Belting.
Binney & Son, Catherine Street, City Road, London, E.C.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Rossendale Belting Co., Ltd., 10, West Mosley Street, Manchester.

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Crank & Iron Co., Ltd., Grantham.
John Thompson, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Cochran & Co. (Annan), Ltd., Annan, Scotland.
Hartley & Sugden, Ltd., Halifax.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
E. & F. N. Spon, 125, Strand, London, W.C.

Cables.
St. Helen's Cable Co., Ltd., Warrington, Lancashire.

Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Southwood, Smith & Co., Ltd., Plough Court, Fetter Lane, London, E.C.
Spottiswoode Advertising Agency, 8, New Street Square, E.C.

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.
H. J. H. King & Co., Nailsworth, Gloucestershire.

Colliery Plants.
Graham, Morton & Co., Ltd., Leeds.

Condensing Plant.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

Condensed Water Purifiers.
Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

Consulting Engineers.
G. H. Hughes, A.M.I.M.E., 97, Queen Victoria Street, London, E.C.

Continental Railway Arrangements.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Brown Hoisting Machinery Co., 39, Victoria Street, London, S.W.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Graham, Morton & Co., Ltd., Leeds.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Coverings (Boiler)
Magnesia Coverings, Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie. Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 47, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Bruce Peebles & Co., Ltd., Edinburgh.
Brush Electrical Engineering Co., Ltd., Victoria Works Belvedere Road, London, S.E.
Crompton & Co., Ltd., Arc Works, Chelmsford.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., The, Silvertown, London, E.
Mather & Platt, Ltd., Salford Iron Works, Manchester.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Premier Electrolyte Co., 26, Spital Square, London, E.
Simplex Steel Conduit Co., Ltd., 20, Bucklersbury, London, E.C.
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Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.

Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Momentum Engine, 19, 19a, Imperial Buildings, Ludgate Circus, London, E.C.
Soest, L., & Co., Ltd., 114-116, Victoria Street, London, S.W.

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Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

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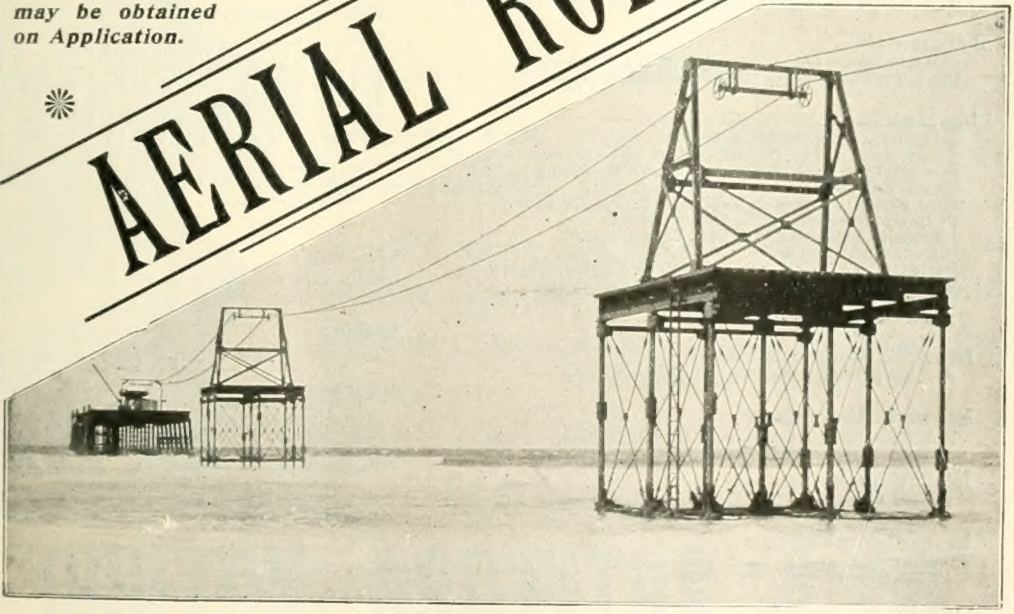

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Hammers (Steam).
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Horizontal Boring Machines.
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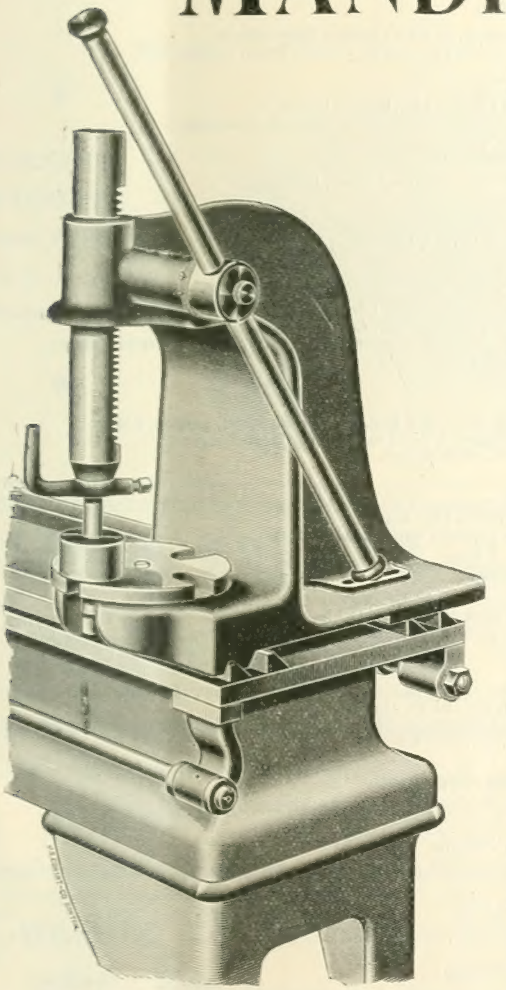

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Gresham Publishing Co., 34, Southampton Street, Strand, London, W.C.
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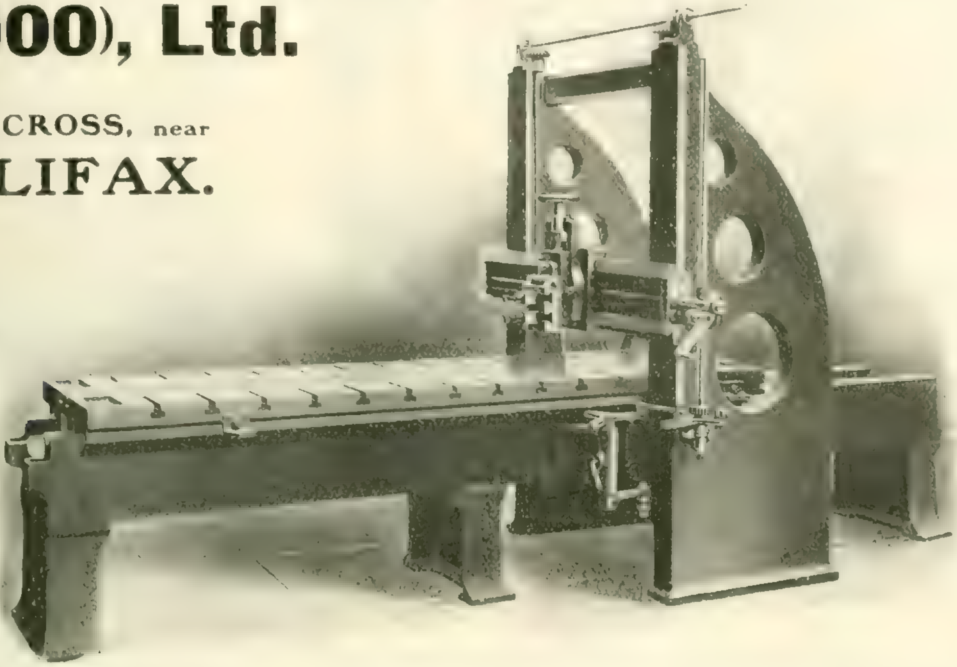

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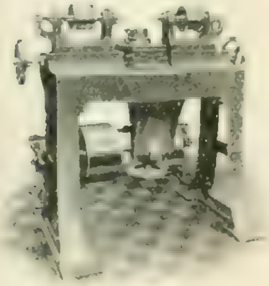

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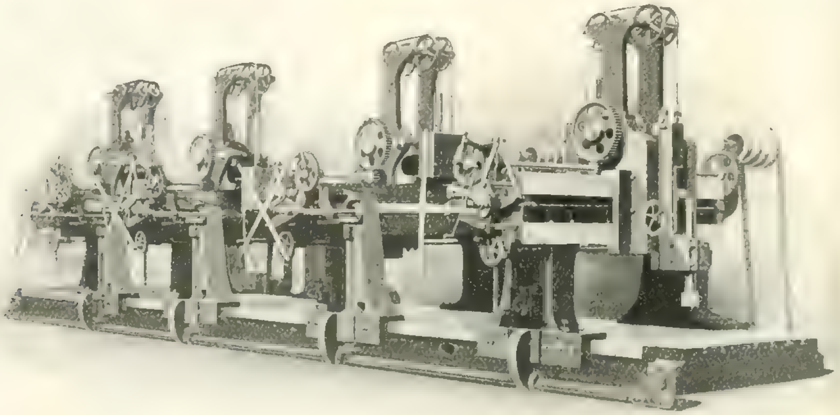

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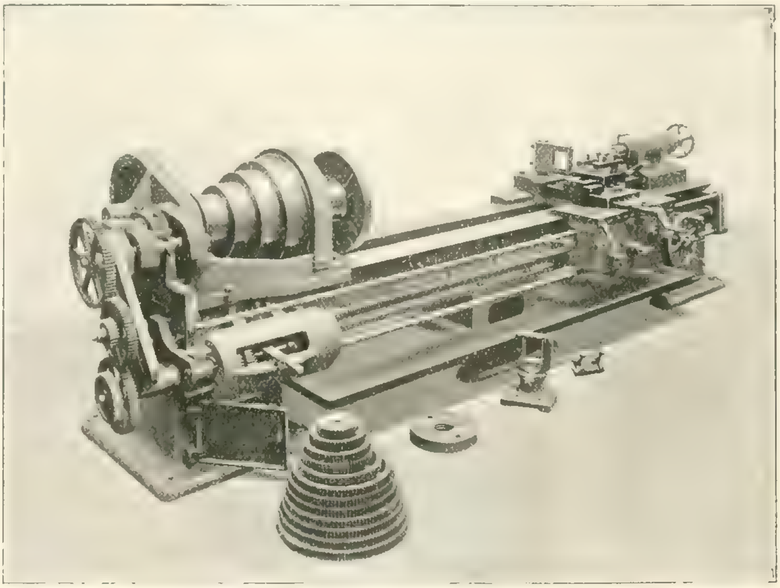

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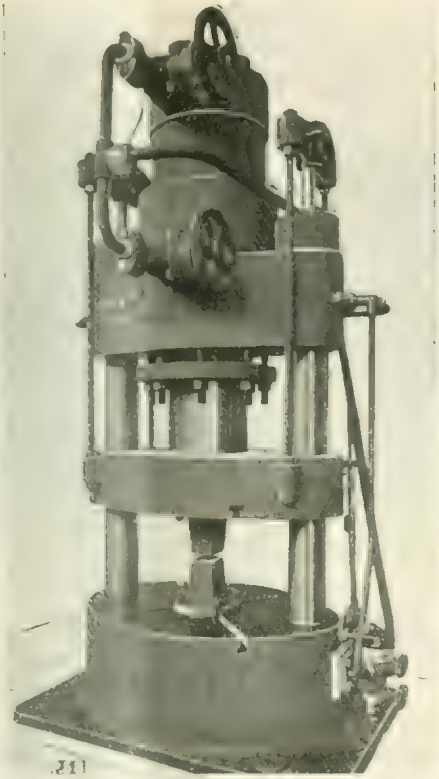

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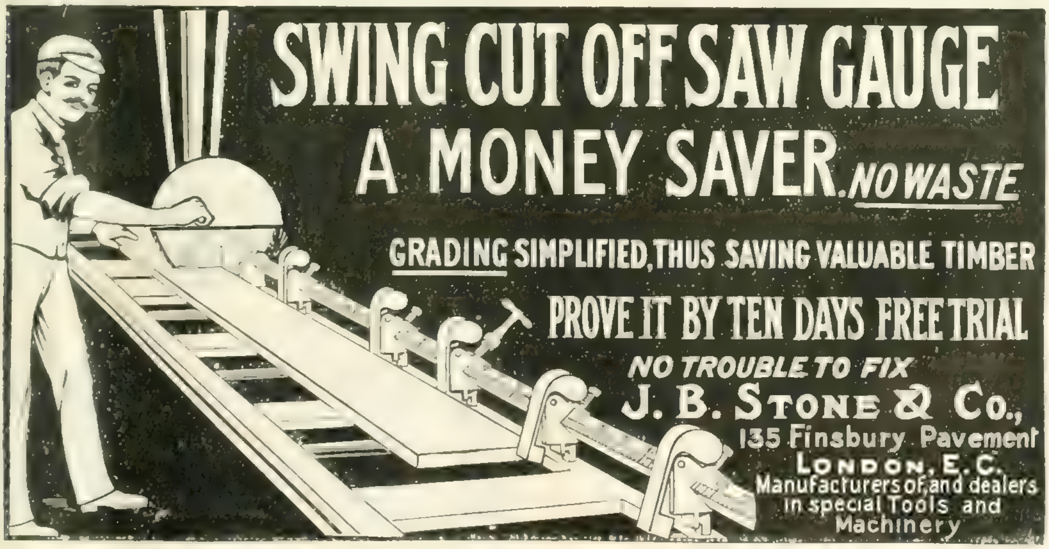

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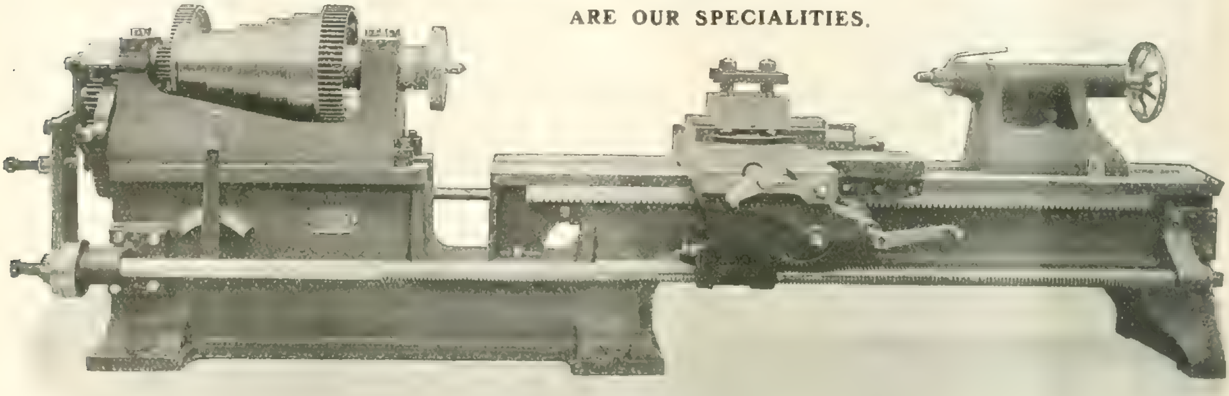

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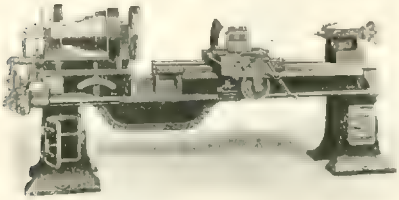

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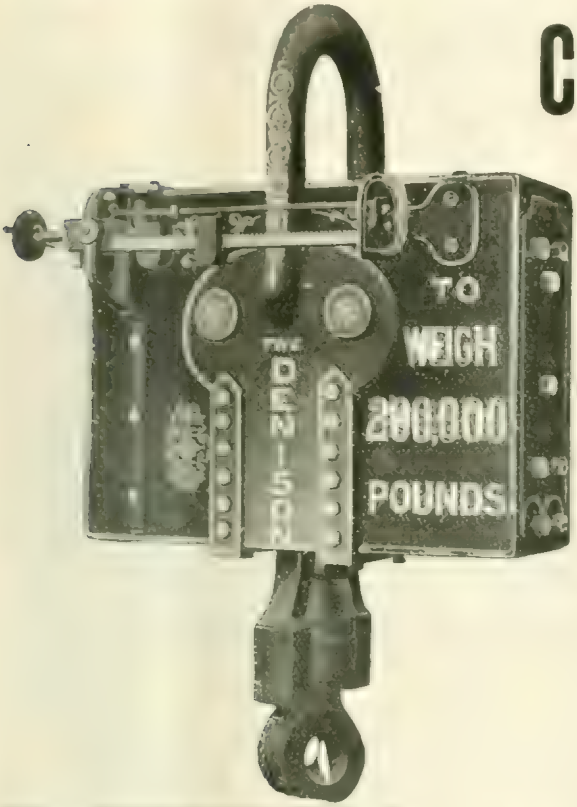

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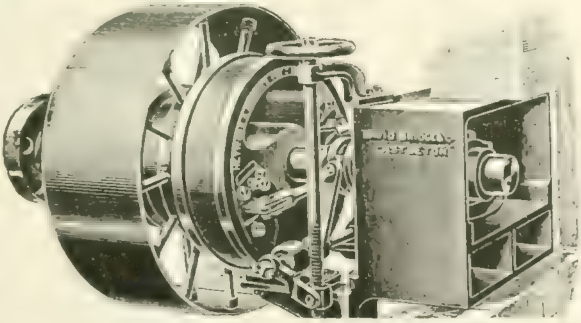

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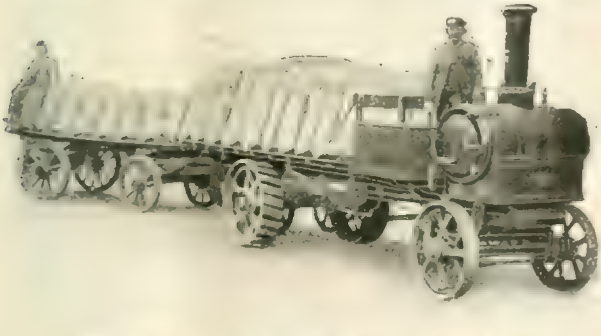

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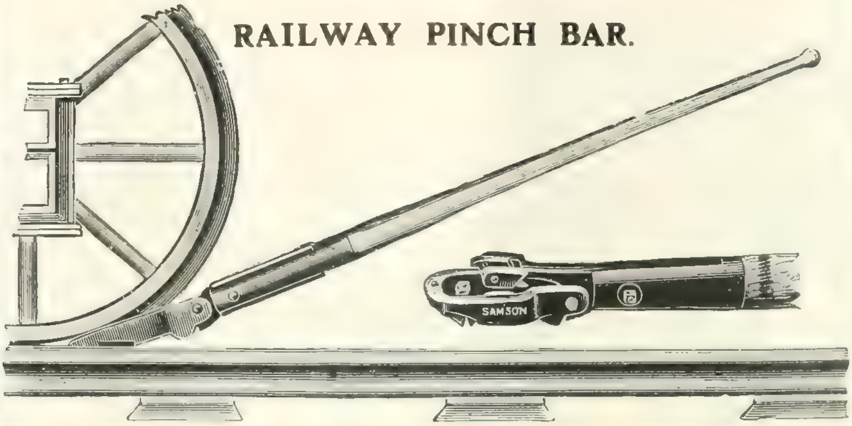

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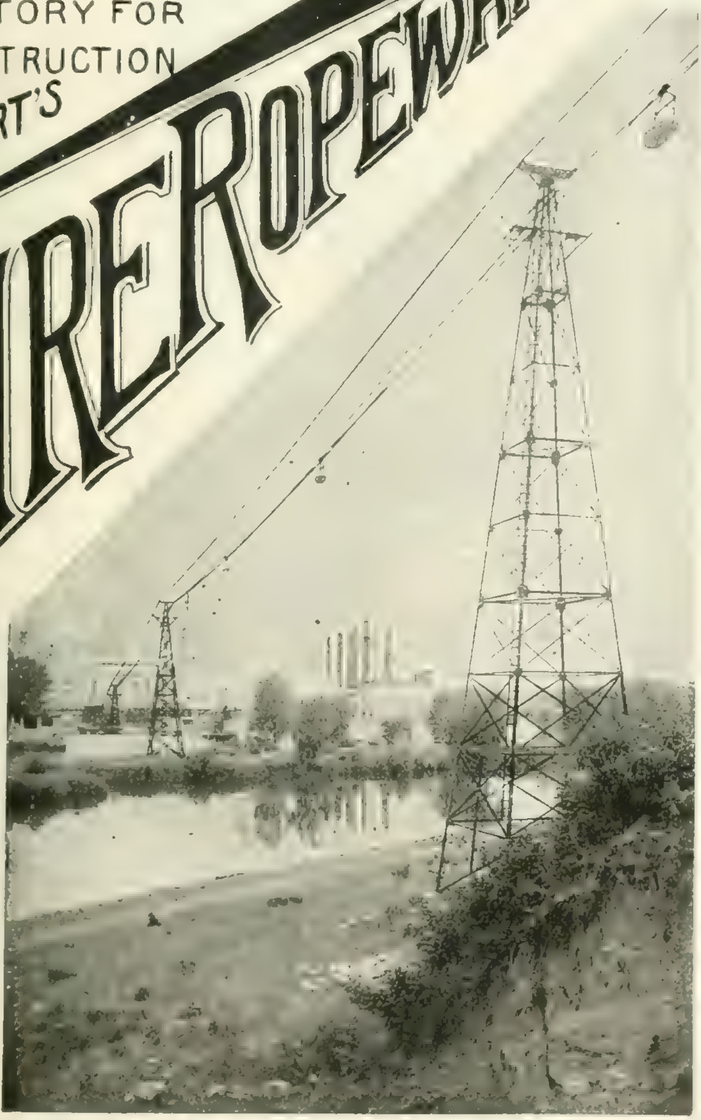

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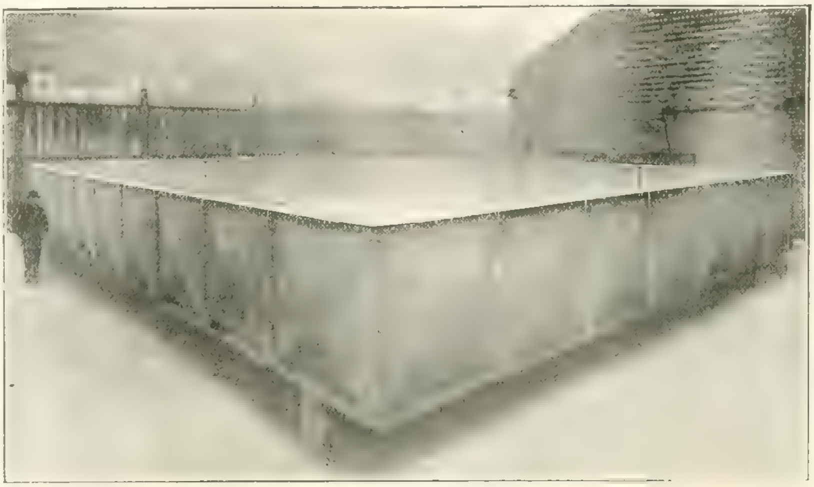

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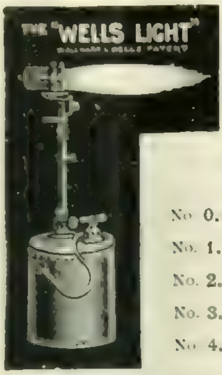

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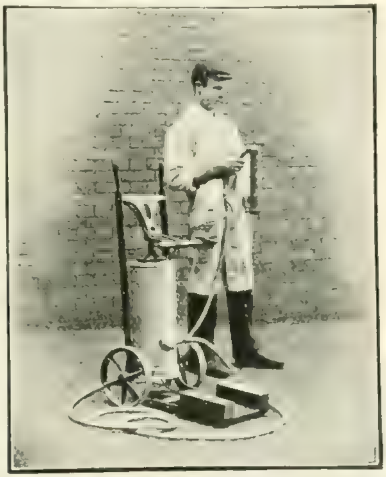

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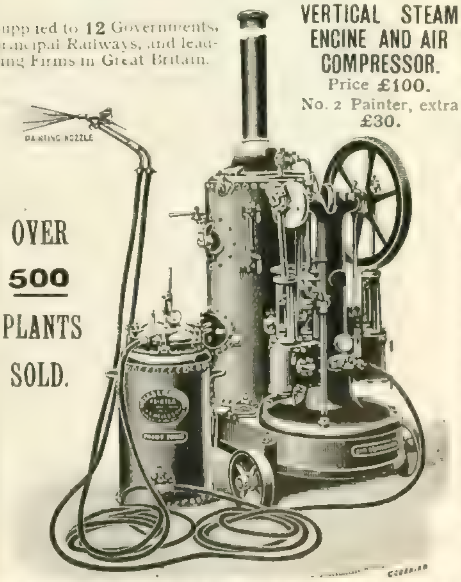

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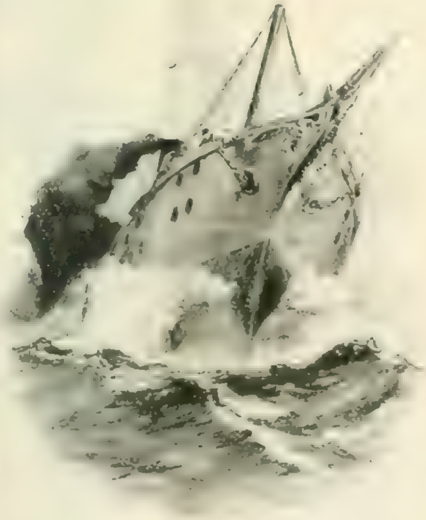

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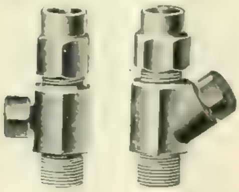

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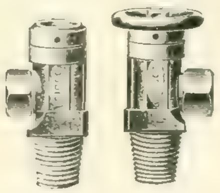

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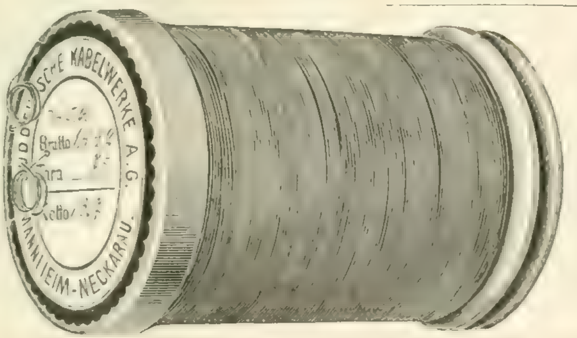
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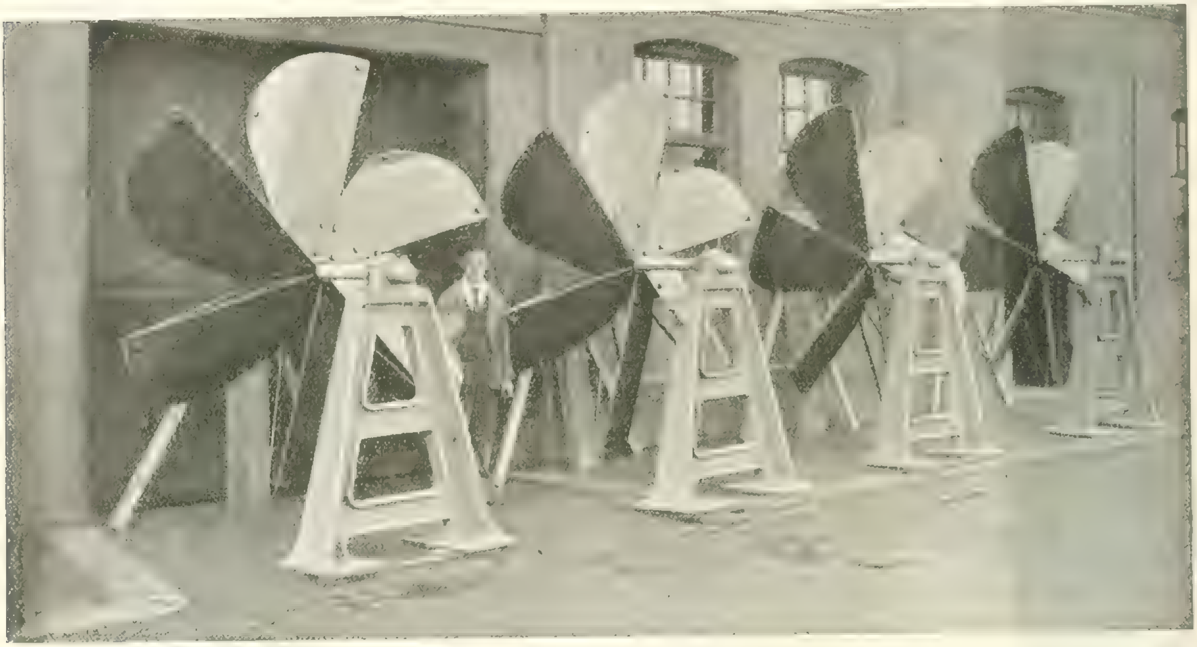

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PAGE'S WEEKLY Miscellaneous

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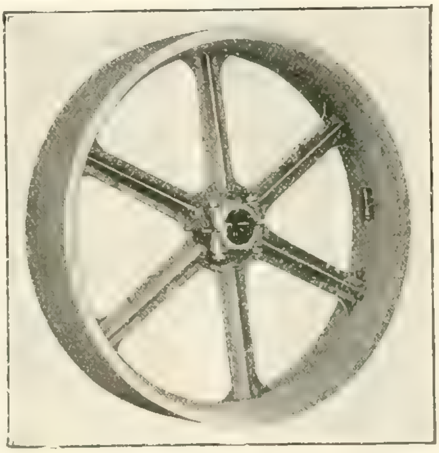

Lighter than iron, stronger than wood, better than either.

These Pulleys will transmit 60 per cent. more power than any Iron Pulley with the same belt tension.

For each ton of less weight on the shaft, less friction, hence less power is required.

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GLASGOW OFFICE: 9, HOWARD STREET.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. V. LONDON, FRIDAY, DECEMBER 9, 1904. NO. 13.

The Offices of "Page's Weekly," Wednesday, Midnight.

ARISING from some remarks of mine in previous issues, several inquiries from steam users as to the best means of detecting weak points in their power plant have come to hand. It would appear from these communications that the practice (extremely prevalent in this and other civilised countries) of employing steam power to do some of our hard work for us, is fraught "with many and great dangers." Either the flywheel is just ready to burst, thus usurping the time-honoured privilege of the steam boiler, or your consulting engineer is "water-hammered" in the course of a professional visit, or there is some unknown danger to be apprehended. Some of these alarms are justified, others are not.

A mill-owner states that he is convinced, since reading the last issue of PAGE'S WEEKLY, that his engine is wasting a great deal of its power through defective exhaust arrangements. I am really sorry if I have made anyone feel uncomfortable, but if I may give my readers a piece of perfectly disinterested advice, I would strongly urge upon every user of steam power the advisability of insuring his plant with one or other of the boiler insurance societies. For a very reasonable annual fee, not only is the boiler thoroughly examined and reported upon, but the engine is overhauled and indicator-diagrams are taken by the society's inspector who will report and advise upon all dangerous defective, or wasteful cases. The responsibility is thus taken out of the hands of the insured,

WIGHAM BUOY IN PORTSMOUTH HARBOUR FITTED WITH THIRTY-ONE DAY PETROLEUM LAMP.

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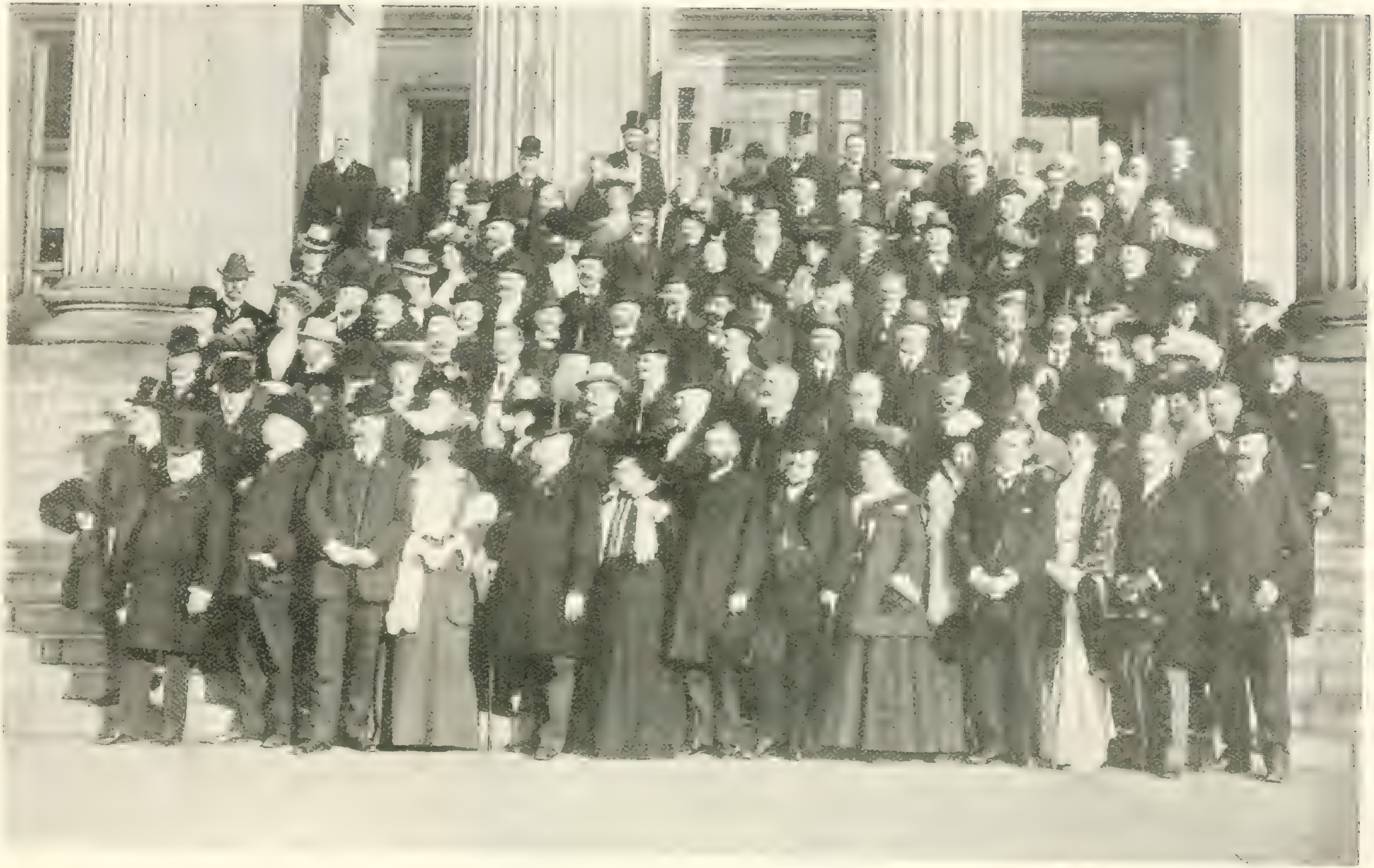
See page [illegible].



GROUP OF MEMBERS OF THE IRON AND STEEL INSTITUTE TAKEN ON THE STEPS OF THE UNITED STATES TREASURY AFTER THE PRESIDENTIAL RECEPTION AT THE WHITE HOUSE.

The names reading from left to right in the front row are: Messrs. W. H. Davies, L. Beijer (Malmo), and A. Lamberton, Sir James Kitson, Bart. (Past-President), Mr. Bennett H. Brough (Secretary), Dr. A. Weiskopf, Mr. F. H. Wigham, and Colonel Cowan, R.E. (second from end).

In the second row are: Messrs. W. B. Ridgley (Controller of the U.S. Currency), B. F. Fackenthal, Bergrath Maurer, P. Schmidt (Hanover), J. Goujon (St. Petersburg), R. N. Renton (Sheffield), and O. Fagawa (Japan).

In the back row are: Messrs. William Whitwell (Past-President), Camille Mercader, and H. G. Turner.

Among others included in the group are: Sir Lloyd Wise, Messrs. T. Wilkinson (Sheffield), Thomas Turner (Kilmarnock), A. Horsfield (Wakefield), W. H. Butlin (Wellingborough), J. C. Custodis, H. Kilburn Scott, J. Magery (President of the Liége Society of Engineers), Ambrose Firth, H. Meachan, H. Owen, F. Noake, A. L. Leigh, James Kerr, J. Verity, H. Butler, R. J. Woodward, James Dunnachie, C. Schultz, Axel Sahlin, F. Sauer, W. Hill, B. T. Broadway, G. Fox, F. T. Rollin, J. Kidner, A. Colley, and J. W. Talbot.

and transferred to the capable grasp of the insuring company.

Only once have I seen a boiler explosion, but it left an impression which will never fade from my memory. It was before the days of Board of Trade inquiries and expert scientific witnesses, and the local jury of small farmers and tradesmen who adjudicated upon the case at the coroner's inquest brought in the verdict of "accidental death."

My more enlightened readers shall judge how far their finding was justified by the facts My story shall be a very short one, but it will bring home to those engaged in the work of making boilers the lamentable effects of putting poor material and inferior workmanship into a steam boiler. One summer's night, a good many years ago, the picturesque village of ——, in one of our inland counties, was startled from its slumbers by a concussion which jarred the glass from the windows, and broke upon the stillness of the night with a thunderous roar and the clatter of falling *debris*. The "steam mill," which, from the earliest memory of the inhabitants, had formed a prominent feature in the landscape, reared its shattered gables from out of a slowly dissolving cloud of smoke, steam, and dust, but the adjacent buildings of the engine and boiler houses were literally razed to the ground, and their material scattered over the adjoining fields. But, worse than this, the pitiful remnants of two unfortunate men were discovered, after anxious search, hundreds of yards apart, one of them in the bed of the mill stream.

It was the day but one after the occurrence that I visited the spot in a professional capacity, with a view of examining the source of all this trouble, the boiler. The boiler, about 16 ft. by 5 ft., gave way through overloading by means of an extra 14 lb. weight upon the lever of the single safety valve. The bursting pressure, as deduced from the safety valve (which, with its incriminating 14 lb. weight, was still lying amongst the rubbish) was only 70 lb. per square inch. The boiler-front, with the flue, and the back end still joined to the shell, lay nearly two hundred yards apart. The angle-iron joining the front and the shell had ripped at the rivet holes and so originated the disaster. There were no gussets, nor any longitudinal stays; and the iron of the plates, and especially of the angle-rings, was not fit to make a rainwater tank of; while the punching of the rivet holes, the drifting, wedging and caulking, which now stood revealed, would have justly procured for the master boiler-maker, had he been living a criminal prosecution on a charge of manslaughter.

I was able to refer briefly last week to the history of Glasgow University as traced by Lord Kelvin. In view of the importance of tha institution as a factor in modern progress, it may be well to review with him the development of the University subsequent to its removal to Gilmore Hill. A few years after this event "the generous gift of £45,000, by the late Marquis of Bute, built the hall called after his name." At the same time the adjoining Randolph Hall and staircase were built by a portion of the legacy left to the University by the late Mr. Randolph. The Queen Margaret College and grounds were presented to the University by Mrs. Elder, who also added largely to the endowment of the Engineering professorship and founded the Professorship of Naval Architecture. Other generous donors have given an engineering laboratory with lecture-rooms, and botanical buildings, and great and much-needed extensions is the anatomical department.

The Carnegie trust and the Principal's University equipment scheme are at present providing two new buildings; one of these is for extensions in the medical school. The other, in which Lord Kelvin naturally takes the most personal interest, is for the natural philosophy department, including lecture-rooms, and a physical laboratory.

DELAWARE RIVER EXCURSION OF THE IRON AND STEEL INSTITUTE AT LEAGUE ISLAND NAVY YARD, PHILADELPHIA.

Among those appearing in the photograph are: Sir James Power (Mayor of Waterford), Messrs. William Whitwell (Past President), R. Williamson, Watson Gray, J. E. Livesey, F. L. Garrison (Philadelphia), Walter Wood, and Tom Westgarth.

NEWS ITEMS.

DURING the week the President and members of the Institution of Gas Engineers received deputations from the gas engineering societies of France, Germany, Holland, Belgium, Italy, Canada, and Australia at the International Gas Exhibition at Earl's Court.

Professor Hele-Shaw delivered a lecture at the Walker Engineering Laboratories on Tuesday on "Gold Mining in South Africa," in the course of which he pointed out that the advent of some 25,000 Chinese on the Rand had led to the immediate occupation of several thousand white men who had previously been out of work. By the end of the year it was estimated that a total of 50,000 Chinese would have arrived, and whatever the political aspect of the question might be there was no doubt, notwithstanding the behaviour of a certain number of them, that the bulk of the men were quiet, hard working, and law-abiding. He remarked that the depression, which had been the natural result of the war, seemed now to show general signs of passing away.

In the Wigham Patent Petroleum Lamp (see page 789) applied to buoys and beacons in all parts of the world, the inventor's plan is to burn the wick horizontally, passing it slowly over a small roller, thus obtaining the light from the side and not from the end, nor from the edge of the wick. The burner is surmounted by a combustion cone, and surrounded by lenticular apparatus; one end of the wick is conveyed up through an oil-tight brass tube, receiving its supply of oil from the oil reservoir through holes in its sides, and the other end brought down through a tube standing above the level of the oil in the lamp, and soldered or secured at the lower end. A circular float is placed in a copper cylinder fixed to the bottom of the lamp, and filled with oil. When the lamp is first lighted this float is at the top of the cylinder, and is attached by means of hooks or loops to the wick. The oil in the cylinder is caused to drop slowly out of it through a valve of peculiar construction, supplied with a cotton core, at such speed as may be necessary. The oil thus slowly descends within the cylinder, bringing with it the float and the wick which is attached to it. At the end of one month, or such other period as may be desired, say two months or three months, it is necessary to replenish the lamp with oil and fit the new wick.

In the case of buoys it is necessary to fix the lamp upon swivels or gimbals, so that, however great may be the motion of the sea, the lamp is kept practically level. Divisions are fixed in the oil reservoir by which, when it is for a moment brought out of level by the sea's action, the oil is prevented from flooding the wick; after the passing of the wave, the proper level is again maintained.

At the annual general meeting of the British Westinghouse Electric and Manufacturing Company, on Tuesday, the chairman, Mr. William I. Buchanan commented upon the influence which the presence of foreign competition in all important tenders exerted upon prices quoted by British manufacturers. The logical sequence to be drawn from the present condition of affairs was that it became necessary for the sales department of a British company to try in advance to discount the unknown outside price, with the net result that much lower prices were made by British companies in such circumstances than would be the case were the competition they had to meet limited to Great Britain alone. It was difficult to see how British manufacturing concerns could adjust their business to meet wider competition, and at the same time satisfactorily uphold even fairly remunerative prices for their products, since they were not able even to make any reprisals, the public policy of their competitors' countries protecting the latter from such attack. To those who directed large specialised companies like theirs, which had to meet this wide competition to a greater extent than did others, there was but one course left open—namely, courageously to use their very best endeavours to meet the situation by economical work, and then to go ahead and secure at the best obtainable price, as large a proportion as possible of the work offered.

Messrs. Meldrum Bros., Ltd., of Manchester have just received from the Admiralty a contract for a "Simplex" Regenerative Refuse Destructor with steam generating plant. This is to be erected at Chatham Dockyard in connection with the large electric power plant which is being installed under the directions of Messrs. Preece and Cardew the Admiralty's Consulting Engineers.

In the High Court of Justice, Chancery Division (Mr. Justice Eady), between D. and I. Tullis, Ltd., and David Kiel Tullis, plaintiffs, and W. Summerscales and Sons, Ltd., defendants—the plaintiffs claimed to restrain the defendants from making what is usually called a "Foul Linen Washing Machine," by writ issued February 27th, 1904. The defendants claimed that they had a right to make the same, as there was no patent attached to it. We are informed that on November 20th the plaintiffs withdrew the case and paid the costs of the defendants, who are now in a position to make the said machine.

NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

THOSE whose memory takes them back to the early days of December, 1902, will recall the multitude of rumours and reports that were then abroad anent reform and reformation in the Navy. Those rumours culminated with the publication on December 25th of the new scheme for the training and education of officers and men. And this change the majority of people contended was all that was to be expected. Such a revolution would be enough, the Board of Admiralty could not inculcate any more changes. But those who knew better the prevailing influences at Whitehall were prepared for more, and all the signs and portents indicate that before many days have elapsed another momentous pronouncement will be made by Lord Selborne.

The many changes that have taken place in high command, in the composition of our active fleets and squadrons, and in the training squadron, have all been commented upon in these notes, and it is needless, therefore, to recount them now that they have met with a large share of attention from the daily press. All the apparently inspired articles in the morning papers prove on examination to be merely collations, from purely unofficial sources, and deductions from movements of warships which the veriest tyro in things naval could not fail to understand. But what these prophets have not been able to tell us, and what no man may yet make public, is the full scope of the reforms and changes which these few published improvements show to be under consideration at Whitehall. Lord Selborne's Board of Admiralty has already made history, before long another perhaps more startling contribution may be expected from the same quarter. We are on the eve of changes, but what those changes may be the Board of Admiralty will not announce prematurely.

Two coincident events this week affected one another very closely, although the connection has not been widely remarked upon. I refer, of course, to the publication of the Report of the Medical Director-General of the Navy and the fatal accident at Portsmouth. The mishap in Porchester Creek is almost unique in its circumstances. That so terrific an explosion should have resulted in so small a loss of life is one of those mysteries which the romance of modern explosives fails to explain. The operations of "creeping" and "sweeping" are extremely dangerous ones in war time, but they are movements which must be carried out. To explain them in detail would require all the space I have at my disposal this week, but briefly they are in the nature of counter-mining operations. A hostile roadstead is mined and it is the duty of the sweeping parties to locate and destroy all or as many of these mines as may be. For training purposes the men of the *Vernon*, torpedo school-ship use Porchester Creek as a hostile roadstead, and there mines are laid. These are then located by sweeping parties, two vessels are connected by a rope, and pass across the mine field side by side. To the rope are attached buoys, to each of which again a rope is fixed falling to the sea-bottom; there, again, is another rope with small charges attached, and as the two vessels steam along, any obstruction, such as a mine, catches and detains this bottom rope. This stoppage is indicated by one of the buoys sinking beneath the surface, and the charge is then exploded by the firing key. However, on this occasion the rope attached to one of the charges must have fouled the screw of the launch, and when the firing-key was pressed, the charge was actually under the stern of the boat. What happened subsequently is known, and the splendid pluck of the men in supporting each other in the ice-cold water during the twenty minutes it took assistance to reach them, is as fine an instance of the bravery of our men as any in modern times.

With the figures and statistics of the Report on the Health of the Navy, I am not here concerned. The report is a satisfactory one, a decrease in the number of cases, invalidings, and deaths, being shown, but it is in the appendix that the real significance of the report lies. There are a number of articles on the Malta fever, an illness which is annually responsible for the loss to the Navy of a number of promising young officers and men. To counteract this disease, is the ambition of every naval surgeon, but up to the present the only preventative appears to be the retention during the greater part of the year of the Mediterranean Fleet in waters to the west of Malta.

Full reports of the trials of the battleship *King Edward VII.* are not yet to hand, but those which have appeared seem to indicate that the trials have been thoroughly successful. The *King Edward's* [illegible] type, three-fifths Babcock and Wilcox, two-fifths cylindrical. The average speed attained on the full speed trial is stated to have been 18·5 knots, and the highest speed 19·2 knots. The coal consumption was large, working out at 2·16 lb. per i.h.p. per hour, and this is attributed to the cylindrical boilers. The builders of the *King Edward's* engines were Messrs. Harland and Wolff, and the same firm have been commissioned to make the machinery for the *Hibernia* and [illegible]

With the launch of the *Britannia* at Portsmouth, this week end, I will deal in my next instalment of notes.

UNITED STATES.

The annual reports from the various departments of the Navy Office are now all published. The most interesting is that of the Chief Constructor of the Navy, who makes some remarks on the question of warship building in the public yards. Although he recognises the desirability for having some of the Government establishments equipped for building naval vessels of the largest size, he considers that the repairing and overhauling of the fleet must at all times remain the important work of navy yards and in time of war their resources will be taxed to the utmost in performing such work. The Navy, he says, is increasing so rapidly that ample work will be provided for the navy yards by "repairs and refits" alone. Of the work on the battleship *Connecticut*, building at the New York yard, the chief constructor says that, despite every effort, to reduce the cost of this, the first battleship to be constructed in a navy yard to the most economical basis, it can hardly be hoped that the work will be done as cheaply as when performed in private ship-building yards whose rates of pay for nine hours' work are in many cases less than those being paid for eight hours' work at the navy yard at New York.

Attention is called to the urgent necessity for adequate docking facilities for vessels of the fleet and for the building of additional piers and general improvement of the berthing facilities at the several navy yards. Many improvements in navy yards are recommended, but the estimated cost of this work is not included in the report.

The state of the vessels building for the United States Navy is eminently satisfactory. In the battleship class the order of completion stands thus: *Rhode Island*, *Virginia*, *New Jersey*, *Georgia*, *Louisiana* *Nebraska*, *Connecticut*, *Minnesota*, *Kansas*, *Vermont*, *Mississippi*, and *Idaho*. It will be noticed that the *Louisiana*, of a later programme, is more advanced than the *Nebraska*, of the *Rhode Island* class. The *Colorado* is first in the armoured cruiser class in point of completion, closely followed by the *West Virginia* *Pennsylvania*, and *Maryland*. The *West Virginia* on her trials recently attained a speed of 22·146 knots, and the *Pennsylvania* last week made an average on a four hours' run of 22·5 knots. Following the first three vessels, come in the order named the *California*, *South Dakota*, *Tennessee*, and *Washington*. In the protected cruiser class the *Chattanooga* and *Galveston* are nearest to completion.

CORRESPONDENCE.

THE STARTING OF LARGE GAS ENGINES.

To the Editor of Page's Weekly.

The Campbell Gas Engine Company, Ltd.,
Halifax, England.
December 1st, 1904.

Dear Sir,—We note the paragraph in your paper of November 25th, stating that although the starting of large gas engines is much better than it used to be, it is hardly as satisfactory as it should be.

The only satisfactory way, and the way which is always adopted, is by having a gas-driven air compressor, usually direct-coupled to the gas engine, compressing air into an air receiver, and the compressed air stored therein is used for starting the large engine. This method gives absolute satisfaction and it is always used.—Yours truly,

(p.p. The Campbell Gas Engine Company, Ltd.),
Hugh Campbell.

To the Editor of Page's Weekly.

75, Victoria Road, Headingly, Leeds.
December 2nd, 1904.

Dear Sir,—With reference to the recent remarks in "Power Station Notes" on the starting of large gas engines, the safest and most convenient way of doing this is to employ an auxiliary gas engine of sufficient power capacity to not only drive the pneumatic machinery of the gas generating plant, but also to supply current for an electric motor for "barring" the flywheel of the large engine. As an additional assistance an explosive hydrocarbon vapour, such as petrol, is introduced into the cylinder and fired; the motion of the engine is then sufficient to permit the exhaust valve to be closed, and compression of a sufficient degree ensured for the efficient firing of the power-gas. This system is very easy and comparatively rapid; a modification may be adopted where the large engine has multiple cylinders, by employing the small engine to drive the large one by belts, or drive a mechanical "barring" gear, until sufficient momentum is obtained as will allow the compression effort in one of the cylinders to be developed. The systems described are those preferred by Mr. Thwaite, whose experience in this direction is well-known to you.

Compared with the starting up of a steam boiler plant and engine of any size, the starting up of a large gas engine, when properly arranged, is not only more rapid but less troublesome, as the starting of a large steam engine by a man who is careless or not thoroughly competent is not without danger and risk to both man and machinery.—Yours faithfully,

J. T. Pullon,
A.M.Inst.C.E., A.M.I.M.E.

THE GAS ENGINE IN IRON AND STEEL WORKS.

By J. H. HAMILTON.

WITHIN thirty years the internal combustion engine has risen from the ranks of a toy motor to a position of importance as a rival to the steam engine in its larger sizes.

The already established advantages of the internal combustion engine are: Economy in the consumption of fuel; convenience in the distribution of gas as compared to steam; small supply of water required; boiler explosion risks done away with; ability to meet sudden demands of power by storage of gas; the recovery of by-products in the process of gas making; the greater simplicity of a gas power plant than of a modern fully equipped steam plant; and, last, but by no means least, the direct utilisation of blast furnace, coke-oven, and other gases, which are themselves by-products in other manufactures, in the gas engine without the intervention of the steam boiler.

In this latter application the economy is most marked, because the loss in turning the heat of combustion of the gas into heat in steam is avoided; but even when gas has to be generated for use in the engine the loss in the gas producer is less than that in the steam boiler. Under ideal conditions it is true that the boiler is as efficient as the most economical gas producer, but with practice the advantage is on the side of the gas producer. The maximum efficiency of each is about 85 per cent., but for everyday work the steam boiler will not average more than 60 per cent. to 65 per cent., and the gas producer 65 to 70 per cent.

THE ECONOMY OF THE GAS ENGINE.

The greatest economy is found in the gas engine itself, apart from other advantages, and the table on page 797 shows that in thermal efficiency the tests exhibited an immense superiority over the steam engine.

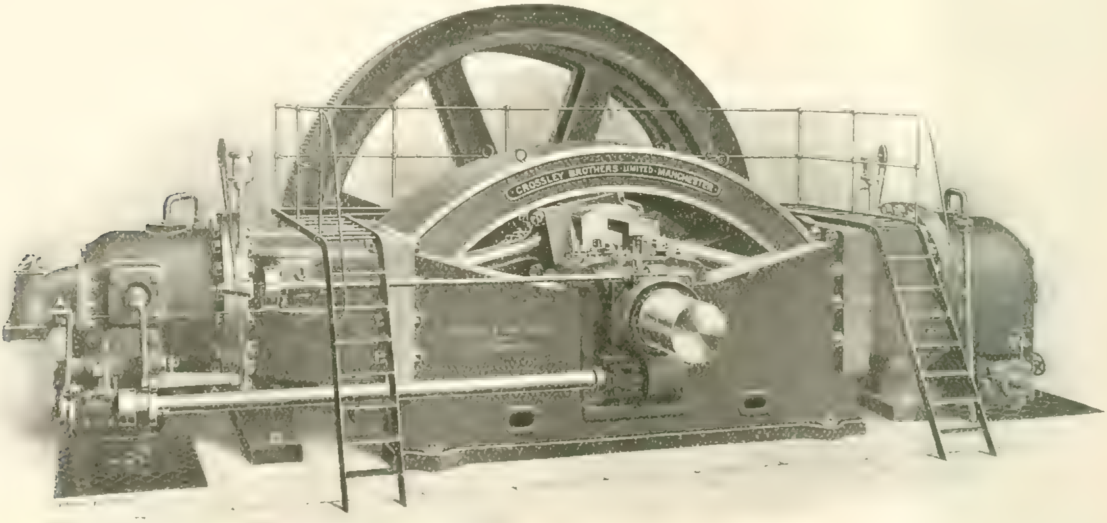


FIG. 1. DOUBLE CYLINDER GAS ENGINE, BY MESSRS. CROSSLEY BROS., LTD., OF MANCHESTER.

THE GAS ENGINE

Type and size of Engine	Kind of Gas	Cubic feet of gas per I.H.P. hour	Consumption of heat in B.T.U. per I.H.P. hour	Thermal efficiency per cent.	Experimenter
"Premier" 500 H.P.	Mond	[illegible]	[illegible]	[illegible]	H. A. Humphrey
"Crossley" 400 ,,	,,	[illegible]	[illegible]	31·2	
"Cockerill" 600 ,,	Blast furnace	[illegible]	[illegible]	[illegible]	Prof. Hubert

THE STEAM ENGINE

Type and size of Engine	Superheat in degrees F.	Pounds of Steam per I.H.P. hour	Consumption of heat in B.T.U. per I.H.P. hour	Thermal efficiency per cent.	Authority for figures.
Compound [illegible] H.P.	295	[illegible]	[illegible]	23	Longridge
Compound [illegible]		14	[illegible]	16·7	Maker's guarantee
Compound	[illegible]	[illegible]	[illegible]	[illegible]	Hiller

If the maximum efficiency of the gas producer or boiler be multiplied by that of the respective engines, we shall get the highest economy which has, so far, resulted from the development of each system :—

The gas power figure is :—

·377 × ·85 = ·32 = 0·57 lb. of coal per i.h.p hour.

and steam power :—

·23 × ·85 = ·1955 = 0·93 lb. of coal per i.h.p. hour.

It need hardly be said that these are not everyday results, and indeed the fortunate combination of the highest efficiency gas producer or boiler, and the highest efficiency engine probably never occurred in practice.

MODERN TYPES OF LARGE ENGINES.

The large engines made in this country and now in use in iron and steel works are as follows :—

FOUR-STROKE TYPE.

"Crossley," by Crossley Bros., Ltd.

"Premier," by the Premier Gas Engine Company, Ltd.

"Cockerill," by Richardsons, Westgarth and Co., Ltd.

TWO-STROKE TYPE.

"Körting," by Mather and Platt, Ltd.

"Oechelhauser," by W. Beardmore and Co.

The "Premier" engine (fig. 3) differs from the other four-stroke cycle-motors in that it is of the positive scavenger type, which means that the products of combustion left in the clearance or compression space of the ordinary four stroke engine are in this type swept out and replaced by air. The larger sizes of the "Crossley" (fig. 1) and "Premier" are made with two or more cylinders, and indeed the largest sizes of every make have multiple cylinders; but the "Cockerill" (fig. 4), "Körting" (fig. 2) and "Oechelhauser" are made in large sizes with a single cylinder. Of these, the "Cockerill" has been built with the largest cylinder that has yet been used in gas engines, viz., 51 in. diameter; but the "Körting" engine holds the record for the largest power developed in one cylinder, this being due to the fact that in addition to the increased number of explosions obtained in the two-stroke cycle, it is also double-acting. The "Cockerill" engine is now also made double-acting, and two double-acting cylinders in tandem, each working on the four-stroke cycle, give two impulses per revolution like the "Körting" engine.

Messrs. Crossley Bros. have avoided the use of piston rods in two-cylinder engines by the obvious expedient of placing two simple single alternating engines on opposite sides of and having their pistons coupled to the one crank. The earlier "Premier" engines were also designed to avoid the use of piston rods.

The most important application of power in connection with iron works is the blowing engine. As the horizontal form is decidedly the best type for large gas engines, horizontal cylinders both for the motor and the blowing part predominate.

Another departure from steam engine practice occurs in connection with the blowing cylinder valves, for the gas engine must run faster than steam-blowing engines usually do, unless, indeed, it is to be very large and unwieldy for its power.

F

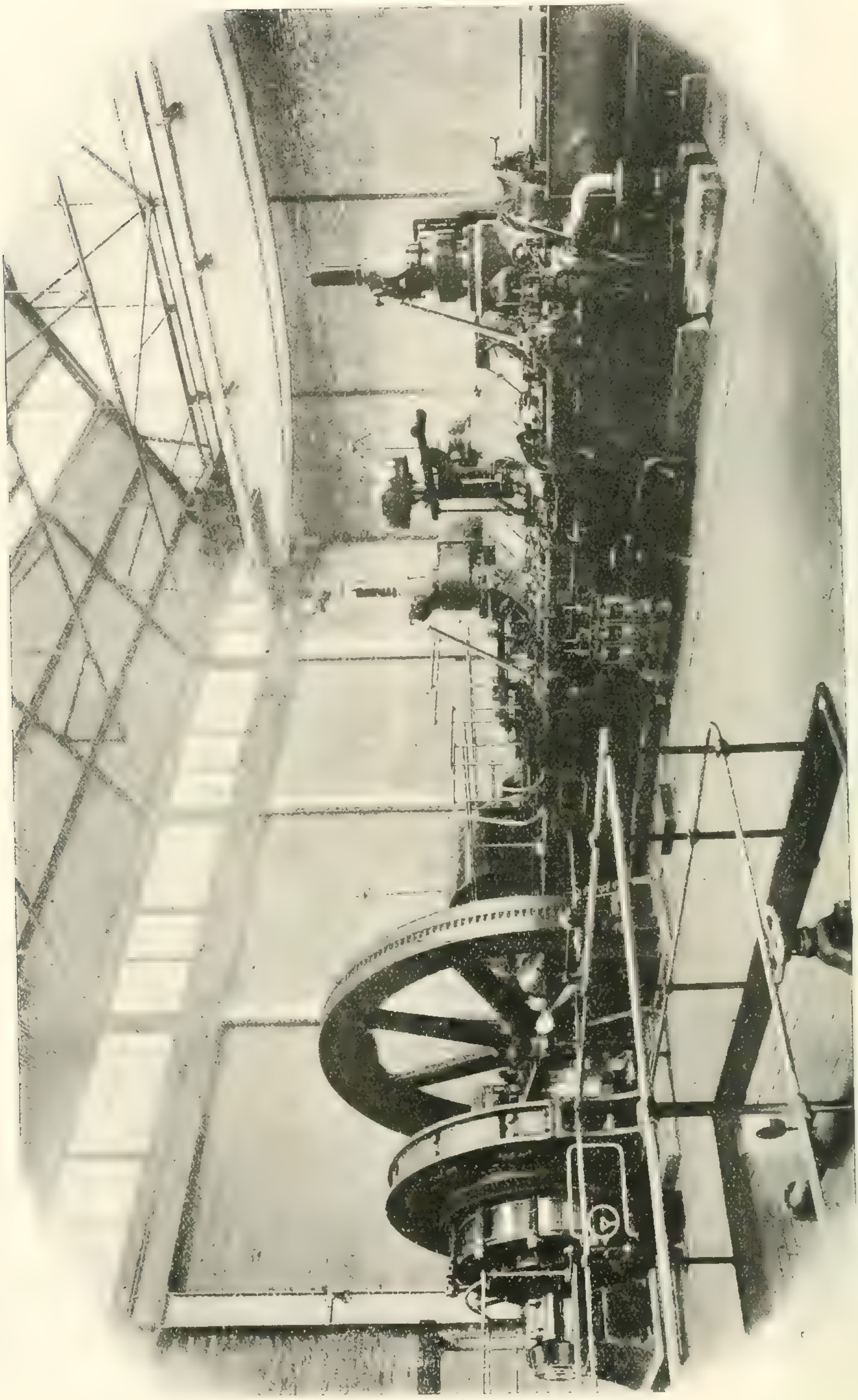


FIG. 2. 750 B.H.P. TWO-CYCLE DOUBLE-ACTING KÖRTING GAS ENGINE AND 500 KW. DYNAMO, BY MESSRS. MATHER AND PLATT, LTD., MANCHESTER.

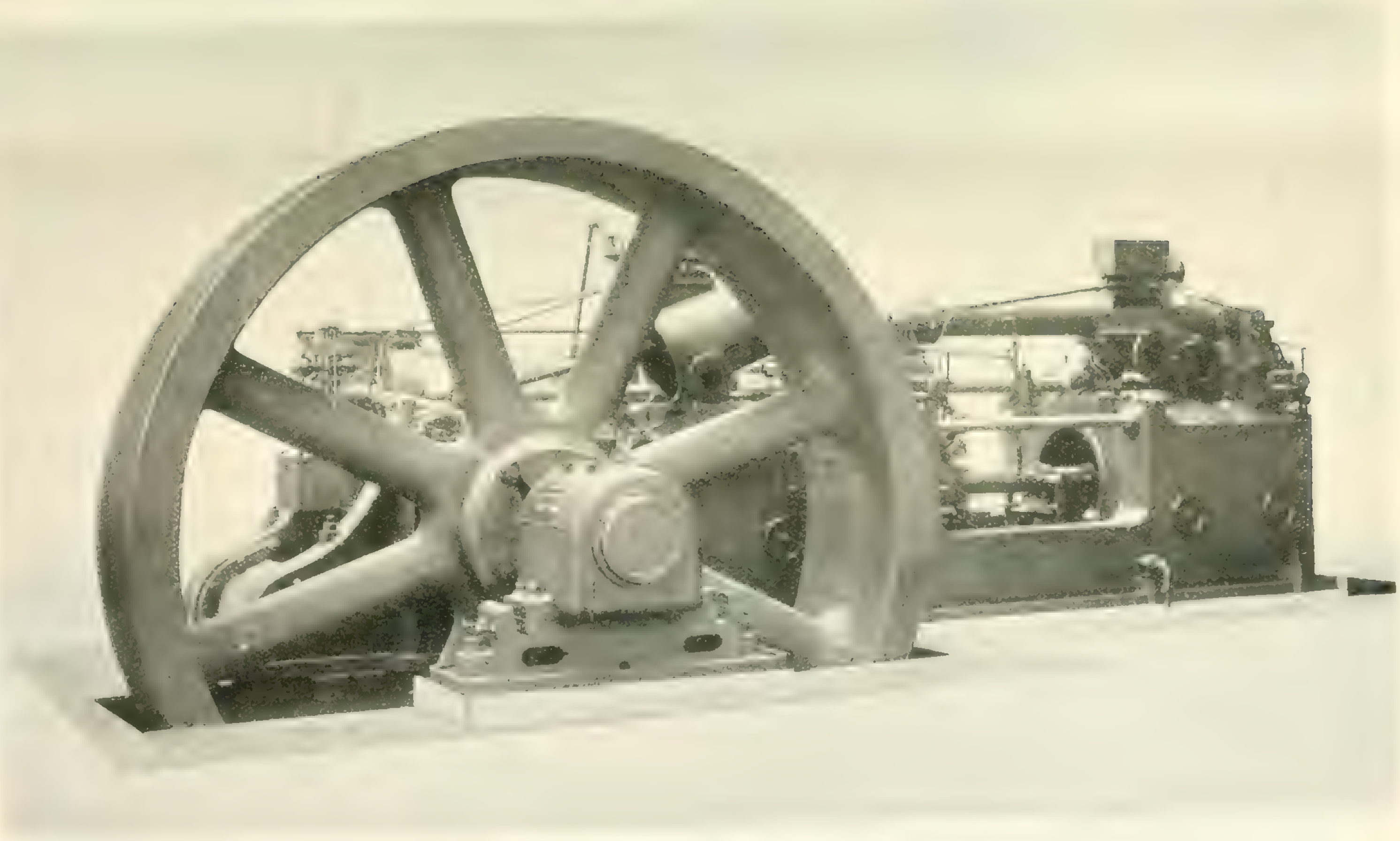


FIG. 3. 400 H.P. PREMIER GAS ENGINE. VIEW FROM FLY-WHEEL.

In the Premier engine the scavenger pump is a separate piece, and is placed in an inclined position above the front cylinder. The water for cooling the piston-rod and pistons is introduced between the cylinders, and consists of swinging links with packed trunnion joints at the pivoted points. The inertia of the water is made use of to insure a proper distribution to both pistons. The gas admission valve is of the slide type, and designed to produce a perfect mixing of the air and gas going to the cylinder, which is a factor in economical working. The admission and exhaust valves are placed in the cover with their axes parallel to the centre line of the cylinder, a construction which avoids pockets or irregularity of contour in the combustion chamber, which have always a detrimental effect. Engines of this type are now working on Mond-gas, blast furnace gas, and coke oven gas.

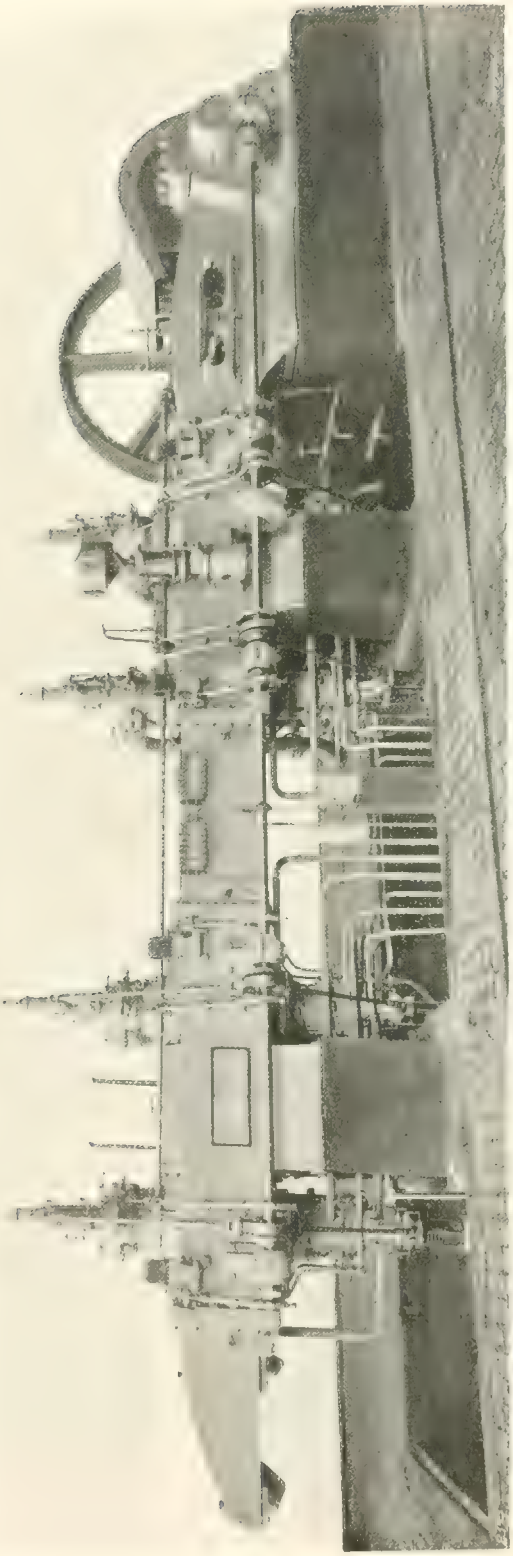


FIG. 4. COCKERILL GAS ENGINE, BY MESSRS. RICHARDSONS, WESTGARTH AND CO.

THE BLOWING ENGINE.

"Premier" blowing cylinders are fitted with grid slide valves in the cylinder covers and positively operated by cams. These valves give a very large and direct passage, and the loss of pressure in passing the valves is consequently very low, an important matter when the large volume of air dealt with is considered. The clearance is also very small.

Messrs. Richardsons, Westgarth and Co.'s recent practice is to use similar valves, but the delivery valve is opened by the pressure of the air on a piston attached to the valve and closed positively by the action of eccentrics.

In a "Premier" blowing engine at Messrs. A. Hickman's works, a special feature of interest is the scavenging arrangement. For this purpose air is taken from the back end of the blowing cylinder by means of a pipe, which also conveys the air required for combustion. The admission valve of that motor cylinder which happens to be making its exhaust stroke is opened towards the end of the stroke, and allows some of the air which is compressed in the blowing cylinder to flow through the clearance space and drive out the products of combustion. The amount of air used for this purpose is very small in proportion to discharge of the blowing cylinder. This is, perhaps, the most powerful gas-blowing engine in England, as it has a good margin of power when driving its 72-in. blowing piston.

For iron and steel makers there is the abiding fact that the gas engine uses their blast furnace gas direct. and for a given amount furnishes many times as much energy as the steam engine, and that its complete adoption in their works will render it unnecessary to consume fuel anywhere except in the blast furances, and furnish all the increasing power which the newer systems of working demand.

Abstract of a paper read before the Staffordshire Iron and Steel Institute.

A COMPARISON OF VERTICAL AND HORIZONTAL TUBES IN WATER-TUBE BOILERS.

By W. R. CUMMINS.

(Continued from page [illegible].)

We can now pass on to the second essential for perfect combustion, viz., heating surface efficiency. The maximum possible heat having been obtained in the combustion chamber, it is the duty of the heating surface to transmit as much of this heat to the water in the boiler and allow as little as possible to escape to the funnel. The maximum possible economy will be obtained when the funnel temperature is equal to that of the water in the boiler, but this would entail such a large amount of highly efficient surface as to make the boiler quite impracticable commercially. The amount of heat allowed to escape to the funnel will of course vary with different circumstances. In some cases weight economy is all-important; the heating surface must be restricted and the funnel losses will consequently be high. In other cases weight economy is not so important as cost economy, and the heating surface must be curtailed to keep down the cost. But whatever the circumstances may be it is evident that the most efficient surface, is, whatever its extent, an unmixed blessing. The most efficient surface may be defined as that type and arrangement of surface which will, under same conditions evaporate the greatest amount of water per square foot. As we are dealing with water-tube boilers only, we need only deal with their most important surface, viz., tube surface. The efficiency of heating surface depends upon:

(*a*) Thickness of the transmitting surfaces.

(*b*) Circulation of the water.

(*c*) Circulation of the gases.

TUBE SURFACE.

As regards thickness of the transmitting surface, naturally the thinner the surface the more efficient it will be. This is assuming them to be in the same state of cleanliness. It is sometimes argued that, as regards transmisson of heat through metal surfaces, the thickness does not affect the amount of heat which can be transmitted, and that with a sufficient thermal gradient the same amount of heat can be transmitted through a thick plate as a thin one. This is no doubt true within certain limits, but it is obvious that there must be a certain loss of efficiency if the final temperature of the gases has (in order to get this thermal gradient) to be kept higher than that fixed by the other conditions. The greatest enemy to heat transmission through any surface is scale on the water side and soot on the fire side. This point will be treated of later on.

The smaller the diameter of the water tube the thinner it will be; consequently small diameter tubes should be more efficient than large diameter tubes.

As regards circulation of the water, it is evident that vertical tubes will give a much better and more reliable circulation than horizontal tubes; or, in other words, tubes when placed vertically can safely be made of much smaller diameter than when placed horizontally. At the high rates of evaporation required of the water-tube boiler, the problem is to keep the tube full of solid water. If a plug of steam is allowed to form, the inevitable result will be the burning of the tube. Various devices have been adopted by users of horizontal tubes to prevent the formation of steam plugs; for instance, in the Belleville (fig. 1) the feed is forced into the lower part of the tube through a fine jet at a high velocity. In the Babcock (fig 2) the tubes are either made of large diameter (as in the land type) or made as short as possible and with additional inclination (as in the marine type). The Durr (fig. 3 and 4), Niclausse (fig. 5), and others have double tubes to ensure circulation. In the Solignac (fig. 6) the lower end of the tube is blocked by a cap through which there is a small aperture.

By arranging the tubes vertically, all these devices become unnecessary and superfluous, for with vertical tubes the circulation is natural, and provided the lower ends of the tubes have free access to the lower drum, and the upper ends are drowned and have free access to the upper drum, burning of the tubes is practically impossible unless the diameter of the tubes is so small as to make them impracticable for constructive and other reasons. A further advantage possessed by the vertical tubes is that they can be so arranged that the free flow of water to the lower end of the tube and the free exit of steam from the upper end is not impeded by having to pass through narrow and sometimes tortuous headers. Examples of this good feature are given by the Cahall, Cummins (fig. 9), Hornsby (fig. 8 and 16) Stirling (fig. 7), Thornycroft, Yarrow and others.

CIRCULATION OF THE GAS.

Passing on now to the third condition affecting the heating surface, viz., circulation of the gas, the problem is to extract the maximum amount of heat from the gases. As the velocity of the gases is of necessity very high, the first essential is to arrange for as long a travel as possible when passing over the heating surface to allow sufficient time for the gases to give up their heat. In many of the express boilers, such as the Yarrow and the Thornycroft, no attempt is made to introduce baffle plates among the tubes. The gases pass through a stack of tubes 2 ft. thick, say, and, once through this, pass direct to the funnel. Taking into consideration the high velocity of the gases, the time occupied in passing through the tubes must be exceedingly short and the result must be an unnecessarily high funnel temperature. In the

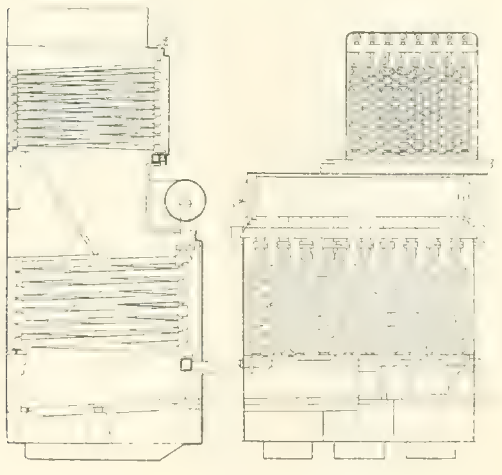


FIG. 1. BELLEVILLE BOILER.

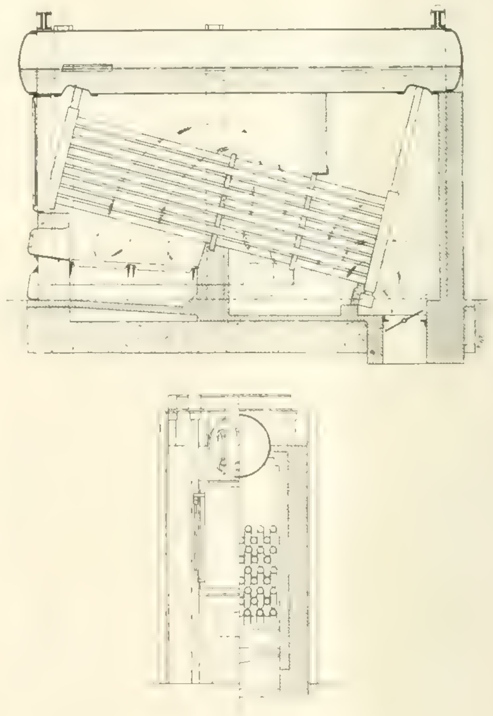


FIG. 2. BABCOCK AND WILCOX BOILER (LAND TYPE).

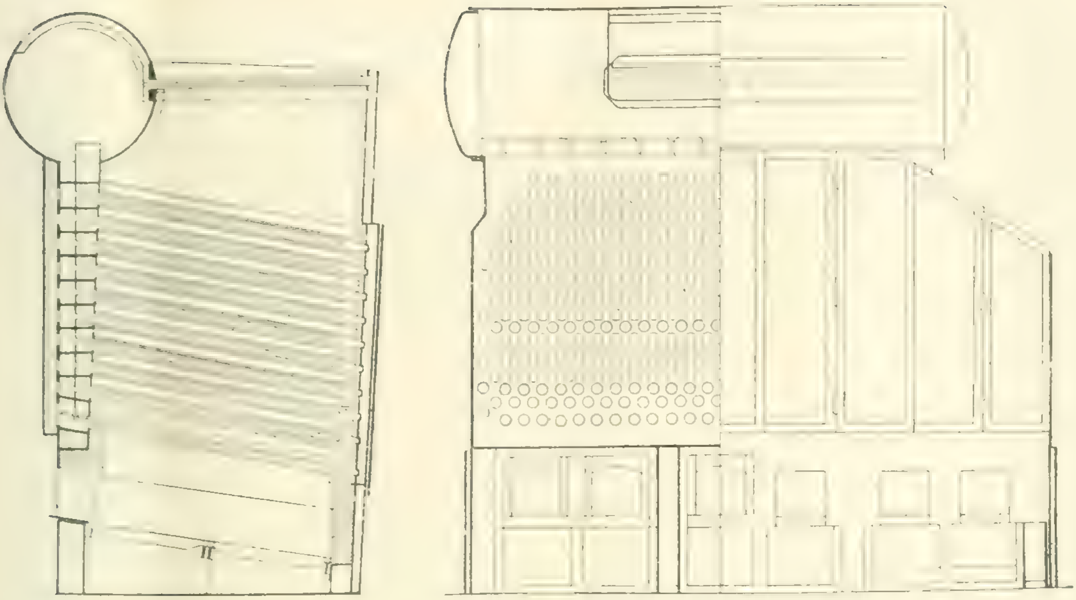


FIG. 3. DURR BOILER (MARINE TYPE).

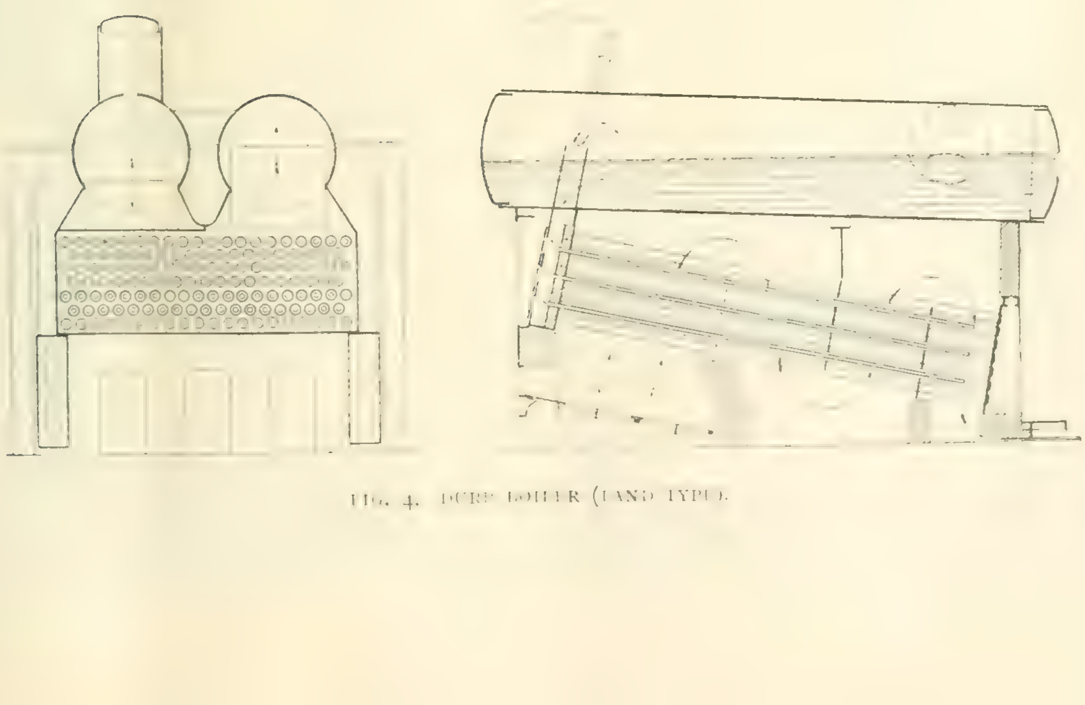


FIG. 4. DURR BOILER (LAND TYPE).

Lagrafel d'Allest—an express boiler—special means are taken to increase the distance travelled by the gas.

AN ESSENTIAL FEATURE.

The next essential is that the gases be split up into as small streams as possible and that these streams be made to impinge on the heating surface, as, when the gases have left the combustion chamber and entered among the tubes, heat will be given up more readily by convection than by radiation ; hence the necessity for intimate contact with the surfaces. In fire-tube boilers the use of spiral retarders have been found advantageous. The effect of these retarders is to break up the hot core in the tube and compel the whole of the gases to come in contact with the tube surface.

It is evident that in order to split up the gases into as many small streams as possible, a large number of small tubes should be used in preference to a small number of large tubes. Staggering the tubes is also an immense advantage, as the streams of gases are being constantly divided and reunited ; in fact, the streams of hot gas wrap themselves around the tubes and thus make use of the whole circumference.

There is only one other point to discuss about the circulation of the gases, viz., whether they should be made to travel in the direction of the length of the tube or at right angles to the length of the tube. The great majority of water-tube boilers make the gases travel at right angles to the tubes, and this appears to be the method best adapted to make the most of the surface. Among the minority who have the gases travelling along the length of the tube are the Stirling, Cahall and Hornsby. In the Belleville, Niclausse, Durr, Babcock marine and other boilers of the horizontal tube type, baffle plates are arranged to give as large a travel as possible to the gases, but the design does not allow of anything much better than a straight run through the stack of tubes, the distance travelled being practically rather more

(*Continued on page 810.*)

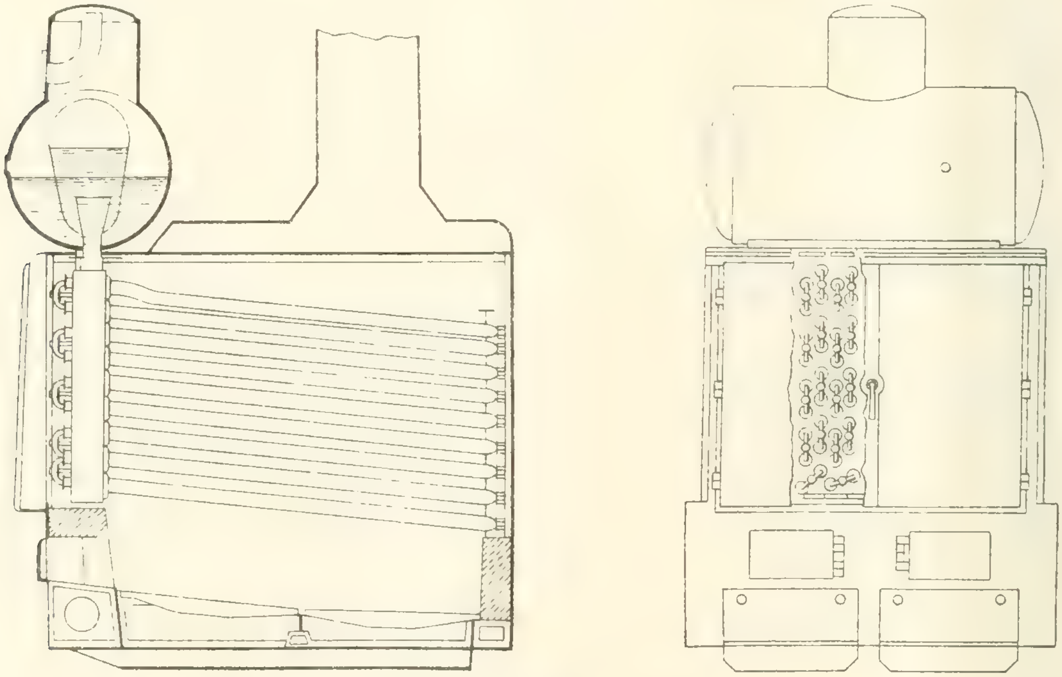


FIG. 5. NICLAUSSE BOILER.

QUESTIONS OF THE DAY

III.—The National Encouragement of the British Inventor: How Can it be Secured?

(continued from page 755)

THIS discussion was initiated by Mr. B. H. Thwaite, C.E., in PAGE'S WEEKLY, for October 28th. In the present instance a number of letters are unavoidably held over owing to pressure upon our space. The correspondence is based upon the questions contained in the following list. Inventors and others who have not yet stated their views are invited to do so.

QUESTIONS ON THE PATENT LAWS.

1.—Do you consider that the new Act will offer a satisfactory solution to the difficulties of patentees and in what direction do you advocate further legislation ?

2.—What is your opinion as to the effect of the yearly fees which, in the event of renewal, are at present payable between the fifth and fourteenth years ? Should the British Patent Department be run so as to produce a profit for the Exchequer by the penalising of the inventor ? Should the Patent fees be reduced to the proportion of those charged by the American Patent Department ?

3.—What do you consider should be the constitution of the proposed searching staff, and how far should the search extend ? Do you consider that the examining staff to carry out the provisions of the New Patent Act should be supervised by a council of practical and acknowledged experts, selected by the Government ?

4.—How many years do you consider patents should run ? Do you think seventeen years' effective duration without further taxation, as in America, an equitable arrangement ?

5.—Have you encountered any instances in which our existing patent regulations have strangled an invention?

6.—Do you consider that the term of a patent life should be proportionate to the importance of the invention, and to the time and money expended in its commercial perfection ?

7.—Is it your opinion that, when challenged, the inventor should be required, at a certain period of, say, any time after four years from the date of application, by affidavit, to prove that he, the inventor, has done his utmost to secure the commerical working of his invention ?

8.—Do you think it advisable that the Patent Department should offer prizes for the encouragement of the inventor ?

9.—Do you consider that the life of a patent should date from the time when it is commercially perfected, but limited to a period of seven years ?

10.—Should a foreigner who has patented an article in England, be allowed to import the article, manufactured abroad, into England, unless he can prove that he has attempted to secure the manufacture on fair terms in this country ?

11.—Should there be a council appointed by the Patent Office Department to determine rates of royalty, and licenses, and take into consideration the time and money risk involved in protecting an invention in order to fix the term of years to be allowed the inventor in which to secure a fair recompense ?

12.—Should patent cases be tested before a special tribunal of technical and legally trained experts, instead of the Judges with little or no knowledge of practical science ?

6, Lord Street,
Liverpool.

To the Editor of PAGE'S WEEKLY.

SIR,—In response to your circular inquiry as regards the Patent Law at the present time, as one of the oldest and largest practitioners in this country, I have pleasure in giving my opinion on each of your questions seriatim :—

(1.) I do not consider the new law will offer a satisfactory solution to the difficulties of patentees. The examination is not thorough, being only through the English patents, and the compulsory license clause is in every way worse in my opinion than the one it supersedes, as that was a comparatively cheap way of obtaining a compulsory license, and this is a much dearer, as the applicant has now not merely to go before the Board of Trade as formerly, but before the Court of the Privy Council, one of the most expensive in the kingdom.

(2.) The great reasons for the great increase of practically new inventions in America over the United Kingdom is the very much greater liberality of the American patent law, the actual stamp duties in America for seventeen years being £7, against £99 for fourteen years in Great Britain. I think, however, that it is well to maintain the annual tax on patents, as a great number of utterly useless patents are kept in force in America solely through there being no way for their expiring before the seventeen years, but 10s. a year would be ample ; and if the taxes were lowered to this extent, it would probably produce very nearly as much to the Government as the present high taxes do, as I have known of vast numbers of really good inventions which have been strangled by these high taxes. In this country, unlike nearly every Continental country, and many of our colonies, patents of addition are not allowed ; consequently, a man has to take out a fresh patent for every new invention on the same subject ; and it is notorious that in a vast number of cases valuable steps in the series of patents have been dropped simply because of the heavy expense of paying the taxes on a large series of patents.

(3.) The Patent Department of the Patent Office at the present time is most admirably conducted, and the men at the head of it are remarkably able and competent, and I do not think that any benefit would result from the Patent Office being supervised by a council of practical and acknowledged experts selected by the Government ; but I do think this, that there ought to be, as in Germany and the United States, an appeal from a primary decision to a higher Court in the Patent Office itself, and for this purpose a council of experts might be employed.

(4.) The general opinion among patent offices throughout the world is that fourteen years is too small, and some of the later laws have been in favour of fifteen or seventeen, to twenty years. I think that seventeen years is not a bit too long.

(5.) I have already answered this question under head 2.

(6.) I do not consider that the term of a patent life should be in proportion to the importance of the invention, and to the time and money expended on its commercial perfection, for the simple reason that I do not think you could get anyone competent to decide the question as to the importance of the invention.

(7.) I do not think there is any advantage in obliging an inventor to prove at any given date from his application, that he has done his utmost to secure commercial working of his invention. The compulsory license clause being made cheaper will supply this defect.

(8.) I do not think it would be advisable at all for the Patent Department to offer prizes for the encouragement of the inventor.

(9.) This has already been replied to under the previous answers.

(10.) I should give foreigners every equality with English patentees, but make the compulsory license clause sufficiently stringent to prevent a foreigner's patent being used dog-in-the-manger fashion.

(11.) I do not think it would be at all advisable for the Government to take any part in deciding what are the right royalties to be paid. A fair compulsory clause would remedy this.

(12.) There is no doubt to my mind that the whole system of patent law practice is rotten to the core, and that a Court in which the Court consists always of one barrister and four or five technical experts having power to engage the services of further experts as independent assessors, if desirable, similar to the higher Court of the Patent Office in Berlin, would be a far superior Court for patent purposes than any at present existing in Great Britain. Our present system of being obliged to employ lawyers, probably entirely untechnical, to argue the case before judges, also entirely untechnical, on an exceedingly technical subject, and the employment of scientific experts before these gentlemen retained by the two litigants, and each of them engaged avowedly to put the case in the best possible manner for his own litigant, and practically throw as much dust in the eyes of the judges as they can, on any matter that is dead against them, is about the most foolish, expensive, and unjust system that could be devised. It gives a vast power to the strongest purse, and patentees are proverbially poor. A permanent Court, consisting of the higher officials of the Patent Office, with one or two barristers of the type of Moulton Astbury, or Terrell, and with power to engage independent experts as assessors, would probably decide the questions vastly much more in accordance with the real rights of the case than our present system of a primary Court and two appeals, while the cost would be enormously less, and they would very quickly get to rely on their own technical knowledge and that of their assessors, as the German Judges do, instead of that of experts paid by the two litigants.

Yours faithfully,

W. P. Thompson.

To the Editor of Page's Weekly.

40, Chancery Lane, W.C.

Sir,—Our present remarks are necessarily limited to the most prominent feature of the new Patents Act, namely the official investigation into novelty. Other important points and suggested reforms would occupy too much space for a single letter. This new provision appears to have received the unqualified approval of those whose acquaintance with Patent Law is of a very meagre kind. Other persons, more versed in the subject, foresee that the inventor will in many instances be greatly harassed by the restrictions attempted to be imposed upon him by the Patent authorities before a complete specification will be deemed to be in a condition for acceptance. An unenviable responsibility will rest with the comptroller or other authorised officer, who will be called upon to exercise the most discriminating care in many a delicate problem; for, whilst prior publication itself will, as before, be no barrier to the grant of a patent *pro tanto*, there is no doubt that a foreseeing inventor will do all in his power to avoid his patent being tainted with an unwelcome allusion to a previous patent or patents, which, so far from interesting him at all, will have become particularly obnoxious to him, having blocked his way to getting a clean and undefiled patent.

We thoroughly agree that a search should be made, but we hardly think that the Patent officials are the best persons to make it. The facilities for public searching in our patent library, as well as in numerous provincial libraries, are unique in the world. There are now on the shelves some eight or nine hundred volumes of abridgments, all indexed and classified, and obtainable at a low price, in which any investigator can search to his heart's content, deriving much useful information at the same time. A person who is interested in upsetting a patent is more likely to find anticipations than an official searcher. We know of instances where patents have been granted in America and Germany, and have afterwards been annulled because of prior patents which the official search did not disclose. It must be remembered, too, that though the search will cover only a portion of the ground that both America and Germany already comprise in their investigations, it will be so expensive as to absorb, we believe, the annual Patent Office surplus of £100,000, and, in addition, require another £1 stamp to be paid upon the sealing of every patent. The hopes of inventors, who were fondly anticipating the time when the patent renewal fees would be substantially reduced, are now finally dashed to the ground, for how can any reduction be made when the available funds (over £100,000 annually, handed over to the Treasury), are now absorbed in the costs of this official search? Further criticism would be needless now that the Act is an accomplished thing. It may be instructive, however, to note the price that inventors are paying for this reform.

It will be gathered, therefore, that our chief objection to the section 1 of the Act is that the burden of search is removed from the public to the Patent Office, both at a time that is premature for judgment to be passed upon the invention and at a cost which is out of all proportion to the advantage gained. Surely this must be admitted, when remembering that not one patent in a hundred is ever tested in a court of law.

At to the value of the search itself, apart from the question of how, when, and by whom the search is conducted, we expect a great improvement in the standard of future patents. The field covered by the official search is to be the preceding fifty years of English patents. As at least 90 per cent. of the prior publications, which in past litigation have been cited against the validity of patents, have consisted of English specifications of less than fifty years old, it follows that a large weeding-out process will take place under the new conditions. Furthermore, the patent specifications of the future will describe and claim an invention in clear and unmistakable terms, whilst probably there will be greater stringency as regards limiting the patent to one single invention.

All these things point to the improvement of the legal status of an English patent, though, of course, any patent granted under the new Act will still be capable of being upset upon the same grounds as before. Applicants, unaccustomed to foreign methods, will no doubt feel irritation in the working of the Act at first, but may it not be that they have been treated much too leniently in the past, so that it has become a common saying that anyone can patent anything?

Yours faithfully,

Stanley Popplewell and Co.

OUR WEEKLY BIOGRAPHY.

PROFESSOR HENRY ADAMS, M.Inst.C.E., M.I.Mech.E., F.S.I., etc.

PROFESSOR HENRY ADAMS, until recently chief of the Engineering Department of the City of London College, has, as we have already announced, retired from that position after a tenure of office extending over an honourable period of thirty-five years. Born in London, March, 1840, Henry Adams may be said to follow an hereditary profession; his father, the late Mr. J. H. Adams,

Photo by Elliott & Fry.

was president of the Society of Engineers, and for three generations his relatives have held prominent positions in the engineering world.

He received his elementary education at private schools, and then became a student at the City of London College. His scholastic career was remarkably successful, he having within three years secured many prizes and certificates, and first place in honours in machine construction and applied mechanics.

His professional training began in his father's office, where his time was employed in designing wharves and jetties; but, being desirous of giving precedence to the study of construction before design, he was apprenticed to the North London Railway Company, serving four years in the Locomotive Department, where he passed through the various workshops and obtained a first-hand knowledge of pattern making, fitting and erecting.

Upon the expiry of his term of apprenticeship, he secured an appointment with Sir W. G. Armstrong and Co. Mr. Adams held responsible positions with this firm for twelve years, during which time he was principally engaged in superintending the building of bridges, lock-gates, and caissons, the equipment of ironclads with guns, erection of cranes, steam and hyrdaulic engines, etc.

Having acquired a comprehensive practical knowledge, Mr. Adams, in 1877, established a successful practice as a consulting engineer and surveyor, and for many years Messrs. Cory and Sons' engineering establishment was under his management. For this firm he designed and constructed six screw tugs, an engineer's shop at Charlton, and two coal jetties at the Victoria Docks. His services were also requisitioned by many firms connected with the Coal Exchange. The extensive depôt of Nine Elms, the property of the Marquis of Londonderry, was constructed from Mr. Adams' plans, and he was also responsible for the Seaborne Coal Wharf, Rotherhithe. He was one of the first to design the modern type of screw tug employed in the Thames, of which the *Tavistock*, built for Messrs. Radford and Co., may be considered one of the best examples.

In 1869, Mr. Henry Adams was elected Associate of the City of London College, and was appointed by the Council a member of the staff of professors. The College has recently undergone some radical modifications which led to Professor Adams' retirement.

The statistics of his classes show that Professor Adams' system of training has been highly successful. No fewer than 3,000 students have had the advantage of his scientific attainments, and throughout the period of his professorship the number of passes obtained by his students at South Kensington exceeded 90 per cent.

Professor Adams is the author of "Strains in Iron Work," "The Practical Designing of Structural Iron Works," "Handbook for Mechanical Engineers," etc., and a series of well-known scientific text-books on "Designing Iron Structures"; he has devised several improvements in machinery, and has patented a floating wharf, overside cranes, locomotive blast pipes and safety fusible plugs for boilers. He has been frequently retained as an engineering expert in law cases, and is often chosen arbitrator in professional disputes. In 1889 he was elected president of the Civil and Mechanical Engineers' Society, while in the following year he held office in a similar capacity for the Society of Engineers. He is a member of the Institution of Civil Engineers, and the Institution of Mechanical Engineers, a Fellow of the Surveyors' Institution, and the Royal Sanitary Institute, and examiner in building construction to the Society of Architects.

THE BURSTING OF FOUR-FOOT FLYWHEELS.

APROPOS of the recent notes in PAGE'S WEEKLY dealing with a few of the points necessary in order to ensure the safe running of flywheels, our readers will doubtless be interested in a paper presented at the annual meeting of the American Society of Mechanical Engineers, held this week in New York. In this, Mr. Charles H. Benjamin presented the results of the latest experiments made in the United States on this subject, his contribution being entitled "The Bursting of Four-foot Flywheels."

Four feet was selected as a limiting diameter for the wheels employed in these experiments and a cylindrical steel casing was built having an internal diameter of 5 ft. The rim or shell of the latter was made of steel 1¼ in. thick, having a tensile strength of about 65,000 lb. per square inch. The flywheel shaft was speeded up by means of a Reeve's variable speed counter-shaft, interposed between line-shaft and the driving-shaft.

The first wheel to be experimented on was a well-proportioned cast-iron pulley, such as is used on shafting for transmitting power. It was 48 in. in diameter, had six arms, and weighed 194 lb. The rim was whole, and was 8½ in. wide and about ⅜ in. thick, finished on the outside. The arms were elliptical in section, 3⅛ in. by 1 1/16 in. at the hub, and 2 in. by ¾ in. at the rim. On the whole the wheel was well designed and showed no signs of shrinkage strains. It had, however, been balanced in the customary manner by riveting a cast-iron washer inside the rim at the lighter side, and this proved its undoing. The combination of a thin place in the rim, a rivet hole and a heavy mass of cast iron, is enough to wreck any wheel. It was necessary to still further weight this side by winding lead wire around the arm just inside the rim. As has been shown by previous experiments on whole rim wheels of cast iron, a bursting speed of 400 ft. per second may be reasonably expected.

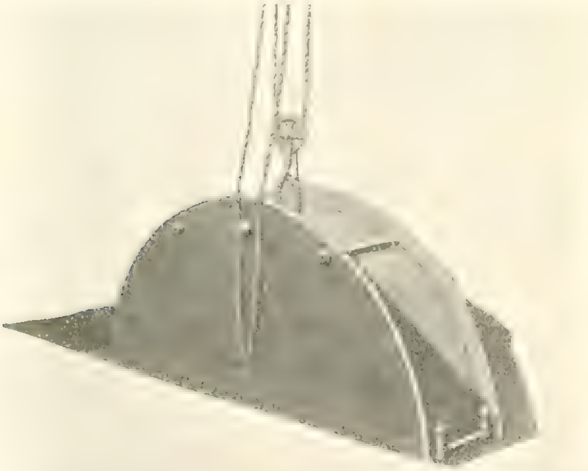


FIG. 1. CYLINDRICAL STEEL CASING USED FOR THE TESTS.

The circumference of a 4 ft. wheel being about 12½ ft., such a wheel should burst at about 32 revolutions per second, or 1,920 revolutions per minute. The pulley in question burst at 1,100 revolutions per minute, as recorded by a tachometer connected to the driving shaft. The balance weight weighed 3½ lb. and its centre was approximately 23 in. from the axis of rotation. At 1,100 revolutions per minute the centrifugal force of the balance weight alone would be 2,760 lb. Add this radial pressure at a weak point between the arms to that due to the weight of the rim itself, and the low bursting speed is easily accounted for. The linear speed of the rim at rupture was 230 ft. per second. As 100 ft. per second is considered the limit for belt speed, this pulley would have a working factor of safety of $(2{\cdot}3)_2$ or 5·3. But suppose the rim had been a little thinner and consequently a bigger weight had been put on with a larger rivet?

Wheel No. 2 was a cast-iron pulley of the same general style and dimensions as No. 1, but with a split hub and rim. The balance-weight was present here as in the former case, but was obliged to yield the palm to its rival, the flanged joint. The wheel had been cast in one piece, as is usual in such cases, with cavities cored at the joints of rim and hub.

After finishing it had been broken apart by wedges making a fracture joint. The flanges, being located midway between the arms and bolted at some little distance inside the rim, were in the worst possible position to withstand the bending action due to centrifugal force, and their own weight only aggravated the difficulty.

The flanges weighed with their bolts 7½ lb. This wheel burst at less than 700 revolutions per minute.

the tachometer not recording below this speed. Mr. Benjamin believes the speed to have been about 600 revolutions per minute. At this speed the centrifugal force of the flanges on one side would have been 1,680 lb. At 600 revolutions per minute the linear speed of rim would be only 125 ft. per second. At the very common belt speed of 4,500 ft. per minute the factor of safety would have but 2·8, which is altogether too low, considering the nature of the material and the shocks to which a pulley may be exposed.

It was reserved for wheel No. 3 to develop the most dramatic series of incidents of any yet experimented upon, big or little. Fig. 2 is from a photograph of this wheel taken just before setting in the case.

It measured 49 in. in external diameter and weighed about 900 lb. The rim was 6¾ in. wide and 1⅛ in. thick, and was built of ten segments, the material being cast steel. This wheel was designed by a Baltimore firm as a model of a proposed 30 ft. fly-wheel. After the wheel had been run at a speed of 1,650 revolutions per minute, it was stopped and examined. The inspection showed fracture of several of the I-shaped prisoners on the outer surface of the joints and a slight opening of the joints themselves, to the extent of perhaps one or two hundredths of an inch.

On June 2nd, 1903, the casing was closed for the last time and the combinations of driving mechanisms set to work. The observers were all well protected, but as the hand of the speed counter reached and slowly passed the 1,600 mark, the feeling of suspense on the part of those watching reached the acute stage. The pointer crept slowly on, and as it quivered on the mark of 1,775, there was a sudden crash, a sound of rending and tearing, and the writer saw the countershaft inside writhing on the floor "like a wounded snake." On stepping outside he was saluted by a shower of falling splinters and fine debris, and was surprised—putting it mildly—to note the disappearance of the greater part of casing and wheel.

The steel rim of the casing was broken off short six inches below one of the flanges, and the entire upper half, weighing half a ton, was projected about seventy-five feet into the air and landed some hundred feet away.

The hub and main spokes of the wheel remained nearly in situ, but parts of the rim were found two hundred feet away, while one large fragment landed on the roof of the building.

This sudden failure of the rim casing was unexpected, as it was thought the flange bolts were the parts to give way first. The tensile strength of the rim at the point of fracture was about 1,200,000 lb., or about four times the strength of the wheel rim at a solid section. Examination of the break in the casing showed a clean, bright fracture, with almost no imperfections.

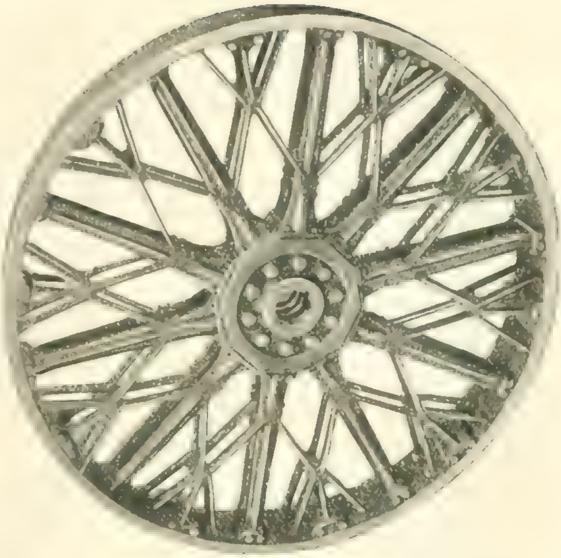


FIG. 2. MODEL OF PROPOSED 30-FT. FLY-WHEEL (WHEEL NO. 3).

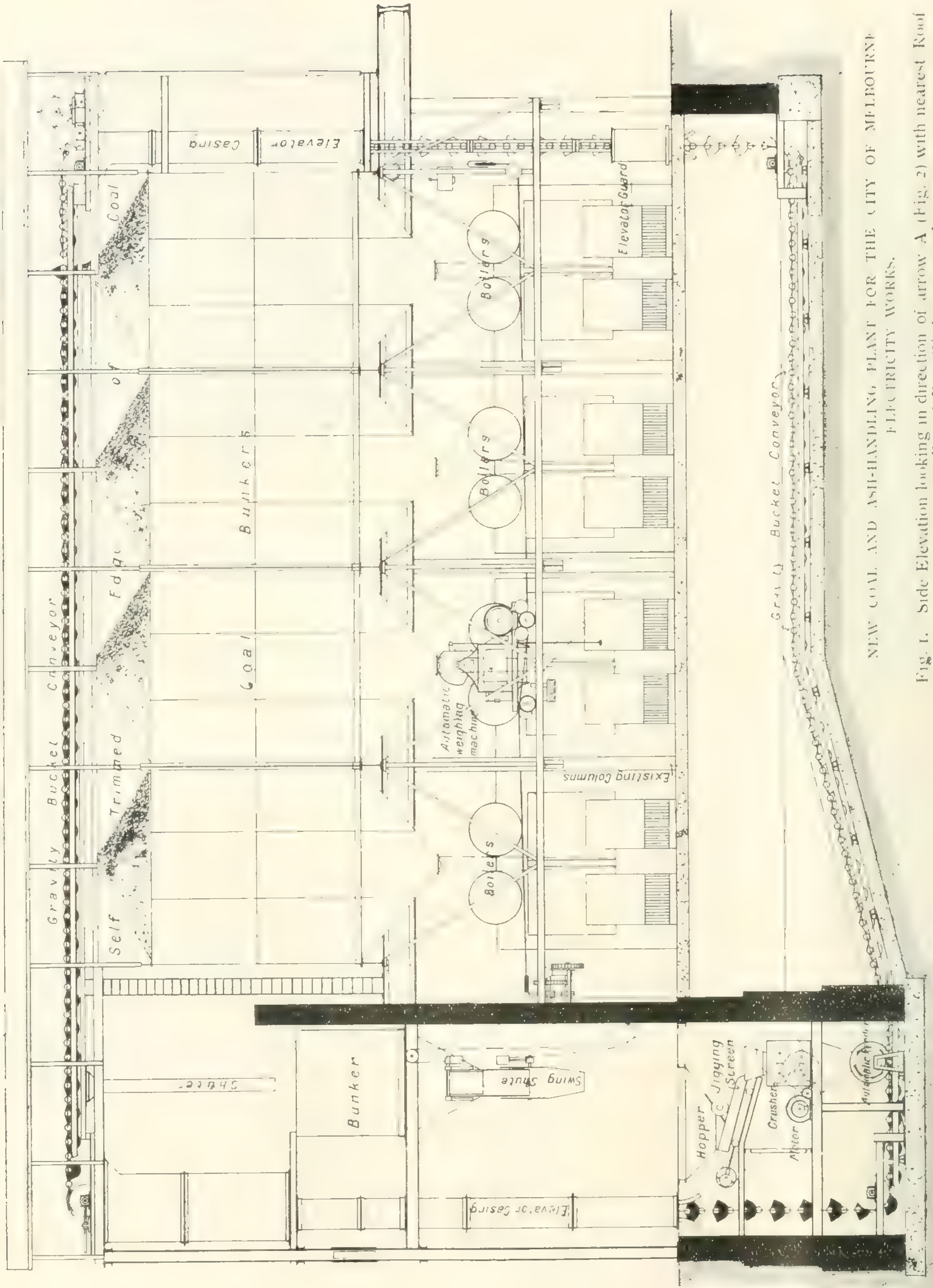
The failure of the wheel itself was due to a gradual opening of the joints, occasioned by the fracture of the outside prisoners, and to flaws in the bronze castings of the arms near their junction with the rim.

On putting the pieces of the wheel together in their original order it was easy to locate the joint which first gave way, on account of the symmetry of the breaks either side of a diameter through this point. It is but fair to the builders of the wheel to say that the fracture showed uniformity of strength and of workmanship, since there was hardly a member of a joint which did not fail in one part or another of the wheel.

One thousand seven hundred and seventy-five revolutions per minute means a linear speed of rim of 22,300 feet per minute or 372 feet per second. This is not as great as the probable speed of a solid cast-iron rim of good design, but it is greater than the speed of any sectional or jointed rim, which has been tested.

The tensile stress due to the centrifugal force at this speed is 13,800 pounds per square inch. This shows that the joints were weaker than the solid rim.

On the whole the test of this particular wheel was disappointing, since its strength was not sufficient to repay one for the expense of the design.



NEW COAL AND ASH-HANDLING PLANT FOR THE CITY OF MELBOURNE ELECTRICITY WORKS.

Fig. 1. Side Elevation looking in direction of arrow A (Fig. 2) with nearest Roof Wall and Box Girder removed.

New Coal and Ash-Handling Plant for the City of Melbourne Electricity Works.

MESSRS. GRAHAM, MORTON AND CO., LTD., Leeds, have just designed, constructed and delivered to the Municipal Electricity Works of Melbourne, Australia, a new and complete coal and ash-handling plant, for the boiler house at the power station.

The contract includes the supply of a coal-receiving hopper, jigging screen, four-roll crusher, Graham's patent revolving filler, and 18 in. standard bucket conveyor, 280 ft. long, a 500-ton steel bunker with roofing, three standard weighing machines, and an ash storage bunker of twelve tons capacity, with the necessary shoots for delivering into carts. The plant is electrically driven by three separate motors.

COAL-RECEIVING HOPPER.

The hopper measures 8 ft. 6 in. by 7 ft. by 4 ft. 5 in. and has a capacity of three tons. It is built up of ¼ in. plate throughout, with 3 in. angles in the corners, the butt joints of the plates being made by means of 5 in. by 3 in. tee iron. The hopper is supplied with 5–16 in. plate wrought-iron slide door, working in 2½ in. by ⅜ in. single iron slides, and operated by means of suitable mechanism. The structure supporting the hopper consists of two 8 in. by 3½ in. channels, 15 ft. 6 in. long built into the pit walls.

JIGGING SCREEN.

The jigging screen is 5 ft. 6 in. long by 2 ft. 7½ in. wide and is built up of ¼ in. plate with 3 in. angle framing. In the bottom of the jigger are arranged twenty 2½ in. by ⅜ in. wrought-iron screen bars, pitched 1½ in. apart, so that all the small coal passes through and is delivered into the gravity bucket conveyor, without passing through the crusher. The jigger is, of course, supplied with adequate fittings and driven by means of eccentrics. The structure that supports it is built up of 6 in. by 2½ in. and 6 in. by 3 in. channels throughout.

FOUR-ROLL CRUSHER.

The crusher is of the four-roll standard type, of 5–16 in. side plates and ⅜ in. end plates, and provided with wrought-iron deflecting plates. The shafts are 4 in. square inside the crusher and are turned to 3⅞ in. diameter outside, permitting the fittings of the necessary gear wheels. The top shafts are supplied with rollers, provided with cast-steel teeth, and are of the claw type. The bottom rolls are supplied with cast-steel rollers, of the plug and point type. The brackets forming the bearings for the shafts

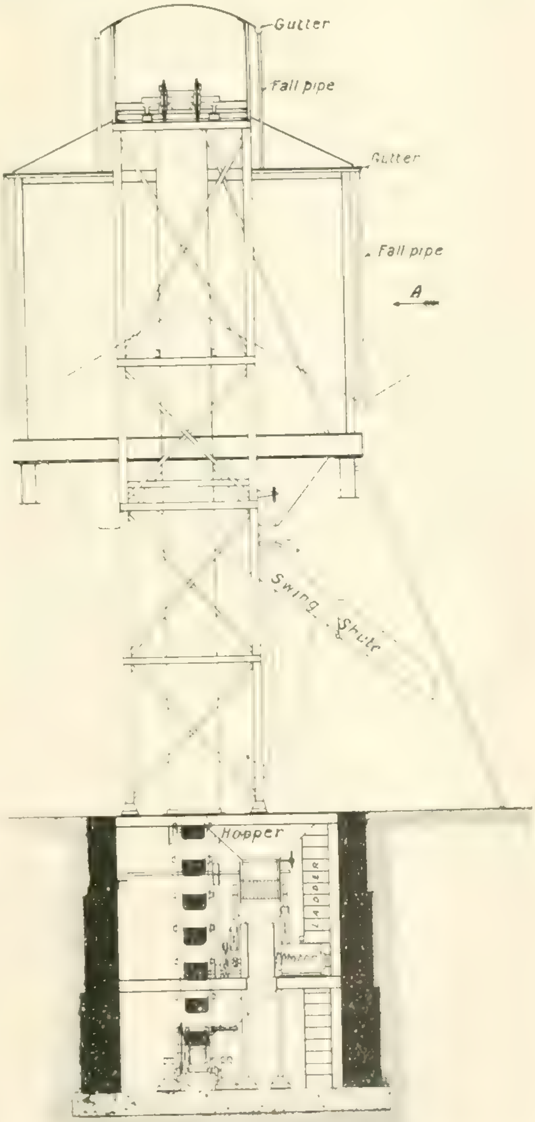


FIG. 2 THE MELBOURNE COAL AND ASH-HANDLING PLANT.

End elevation.

are of cast iron bushed with white metal, and are bolted to the side plates of the crusher.

REVOLVING FEEDER.

A wrought-iron by-pass shoot delivers all the small coal from the crusher to the revolving feeder. The structure supporting the crusher is built up of 8 in. by 3½ in. channels, the channel pillars being provided with standard feet. In position in the crusher pit is Graham's patent automatic revolving feeder which, as its name implies, automatically feeds the conveyor and prevents the spilling of the coal over the sides and ends. It is built up in the usual manner with a revolving cast-iron body plate, provision being made for driving by means of a cast-iron sprocket-wheel from the conveyor chain.

BUCKET CONVEYOR.

An important portion of the plant is the 18 in. standard gravity bucket conveyor of a total length of 280 ft. It is of the tilting bucket type; the buckets are of steel, riveted and supplied with suitable tilting cams. They have overlapping lips, which obviate the possibility of spilling the ash as it is carried. The buckets are suspended from the chain by means of 1½ in. diameter steel spindles. They are supplied with cast-iron rollers, 6 in. diameter, the bosses are screwed to receive the cast-iron lubricators, the latter being fitted with spring clips. The conveyor is provided with a double strand of chain, formed of steel links 2½ in. by ⅜ in. thick. Throughout its entire length it is supplied with rails, both on the horizontal and vertical runs. The bottom rails are supported by cast-iron brackets, from off the floor of the trench, they are securely attached to the floor by means of ¾ in. diameter rag bolts.

The rails over the storage bunkers are kept in position by means of two 8 in. by 3½ in. channels, each 71 ft. 2 in. long, supported by means of 8 in. by 4 in. rolled steel joists, built up of 8 in. by 3½ in. channels.

Alongside the top run of the conveyor is a walking gantry of 4 in. by 2½ in. angle iron runners borne on cross joists and provided with wrought-iron chequer plates, 2 ft. wide. The driving and trailing end fittings consists of 32 in. diameter cast-iron end wheels, mounted on 4 in. diameter shafts, and one set of end fittings is further provided with adjusting screws for adjusting the length of the chain. The structures for supporting the guide rollers are built up of 5 in. by 3 in. bulb angle and ⅛ in. casing. The trailing-end fittings are supported by 8 in. by 4 in. cross-joists and 8 in. by 3½ in. longitudinal channels.

Four sets of standard tilting gear are arranged on the top run of the conveyor. Steel rollers, mounted on wrought-iron levers engaging with tilting cams on the sides of the buckets and being so arranged as to cause the buckets to dump their load at each of the desired points, constitute the tilting gear.

THE COAL-STORAGE BUNKER.

This appliance measures 60 ft. long by 20 ft. wide, by 21 ft. 3 in. deep. The sides are built up of two tiers of plates, the top tier being ¼ in. thick, and the bottom tier 5-16 in. thick, the bottom plates are ⅜ in. thick. This bunker is provided with 3½ in. angle frames both in the corners and alongside the top edge; the vertical butt-joints of the plates are made by means of 5 in. by 3 in. tee iron, but the horizontal butt-joints of 4½ in. by ⅜ in. flat bars; gusset plates are provided and the bunker is, of course, securely braced. It is supported on five 18 in. by 7 in. rolled steel cross-joists, each about 22 ft. long and attached to the existing longitudinal main girders.

The principals supporting the necessary roof over the storage bunker are built up of 4 in. by 2½ in. channels, the purlins being 2½ in. angles. The roof is covered with 20 B.W.G. corrugated sheeting, and the light is admitted by skylights.

It is interesting to note in this connection that while the bunker was in the workshops no less than 400 engineers from all parts of the country, who visited the contractor's new engineering works, inspected it and unanimously pronounced it to be a fine piece of work. Built up from the bottom of the bunker are the brackets for supporting the weighing machine, the rails for the same are of 6 in. by 3 in. channel iron runners, which are bolted to the wrought-iron brackets.

WEIGHING PLANT.

The three weighing machines, furnished with delivery shoots, have a combined capacity of 15 cwt. per operation. They are provided with suitable gear for automatically recording and accurately weighing every load, indicating the total on a dial. After being weighed the coal passes direct to the stoker-hoppers.

A special point of interest that distinguishes these weighing machines is the arrangement of a swivel-shoot so adjusted that the end of the shoot, when travelling, nicely clears the vertical columns carrying the overhead bunker. Eight outlets and slides are provided on the bottom of the bunker, operated from the firing floor level by adequate mechanism. The weighing machines are driven from a motor at one end of the boiler-house, the power being transmitted by means of cotton rope.

The roof and louvre over the conveyor is supported on principals built up of 4 in. by 2½ in. angles with 3½ in. eave stringer angles for the eaves. The louvre is covered with 20 B.W.G. corrugated sheeting, and the louvre blades are made of 20 B.W.G. galvanised sheets, 4 in. projection. Iron guttering and fall pipes supported on the necessary brackets complete this portion of the work.

THE ASH PLANT.

The ash-storage bunker is of wrought iron. It is 8 ft. square by 12 ft. deep, built up of ¼ in. plate with 3 in. angle frames, the butt-joints being of 5 in. by 3 in. tee irons. A slide door, with levers and balance weights, is provided. The ash shoot is built up of 3-16 in. wrought-iron plate. Over this there is a set of standard tilting gear, for tilting the buckets when full of ash and delivering into the storage bunker. On the underside of the bunker is a ¼ in. plate wrought-iron hinged delivery shoot, the hinge permitting the shoot to be lifted up when not in use, so as to allow more head room.

The vertical run of the conveyor and the ash-storage hopper is contained in a tower, which is built up of 10 in. by 6 in. rolled steel joist pillars, and 6 in. by 3 in. cross channels; the pillars are provided with standard feet, and cross-braced with flat-bar bracing. The ash-bunker is attached to the structure by means of 10 in. by 3½ in. channels. The rising and falling portions of the elevator are cased in with ⅛ in. sheeting, jointed by tee-iron frames.

Access is afforded to all the working parts of the conveyor and to other portions of the plant, where desirable, by means of wrought-iron ladders, gantries, etc.

The crusher pit and trench over the bottom run of the conveyor is covered in on top with wrought-iron chequer-plates, with the exception of the receiving hopper.

The motor for driving the crusher is 12 b.h.p. running at a speed of 600 revolutions per minute; that for driving the coal conveyor is of 15 b.h.p. running at the same speed. They are of the enclosed ventilated type and suitable for a three-wire direct current of 460 volts across the outers, the middle wire being earthed. After six hours on maximum load no parts of the motors have a higher temperature than 70 deg. Fahr. above that of the surrounding atmosphere. Suitable starting and regulating rheostat and switches, overload release gears, etc., are provided.

The gearing for driving the plant is also supplied by the contractors.

This contract in its design, construction and delivery, would seem to suggest that for British engineers adopting thoroughly modern methods in doing business, there is a great future open in the prospective trade of Greater Britain

OBITUARY.

THE death is reported of Mr. Samuel Massey-Jones, formerly works manager of the Shelton Steel, Coal and Iron Company.

After a prolonged illness, the death occurred, on the 22nd ult., at Vaynol, his residence near Bangor, of Mr. G. W. Duff-Assheton-Smith, owner of the Llanberis Quarries.

Mr. Thomas Burn, M.E., will be remembered for his long connection with the Barrow Hematite Company with which he first became associated over 30 years ago.

The late Mr. T. Gladstone of Birmingham, although not latterly directly connected with iron and steel or engineering industries, was one of the original directors of Nettlefolds, Ltd,, now absorbed in Guest, Keen, and Nettlefolds.

Mr. Herbert Le Neve Foster's sudden death recalls that of his brother Sir Clement Le Neve Foster. The deceased was well known in metallurgical circles. He carried on business at Birmingham and managed the Pwthwyllan quarries of Ruabon.

In ex-Bailie John F. Miller, Glasgow has lost a public figure. Mr. Miller was born in 1848, and in 1870 became a partner in his father's business—James Miller and Co., nut and bolt manufacturers—and on the conversion of that firm into the Rivet, Bolt, and Nut Company, Ltd., in 1895, he was appointed chairman of the company, which position he continued to hold until his death.

The death occurred recently of Mr. Cornelius Shields, at Sault Ste. Marie, Ont., at the age of 49 years. Mr. Shields was born in New York State in 1855, and began his business career with the Northern Pacific Railway. Latterly Mr. Shields was the general manager of the Consolidated Lake Superior Company of the Sault Ste. Marie Steel Works.

Dr. T. M. Drown, whose death is reported, was the President of Lehigh University, and the secretary for many years in its earlier days of the American Institute of Mining Engineers. Dr. Drown, who was a leading authority on the chemistry of iron and steel in America, had been a member of the Iron and Steel Institute since 1886 and took part in the meeting of that society in New York last month

(*Continued from page 804.*)

than the height in each case. In the Babcock land boilers the gases are given a long travel by means of vertical baffles. The Stirling and Hornsby also secure a long travel by vertical baffles on the nests of tubes. In the Cummins' boiler a long travel is secured by fitting a vertical baffle outside the innermost row of tubes. This baffle extends round seven-eighths of the circumference, and the gases are taken away to the funnel from a point opposite to the gap thus left in the baffle.

Summing up the conditions affecting fuel economy, it can safely be said that a large and high combustion chamber is an absolute necessity; that vertical tubes, as small in diameter as practicable, are preferable in all respects to horizontal ones. It is equally important that the gases, on leaving the combustion chamber to enter among the tubes, are not rushed through too quickly, but are allowed sufficient time to give up their heat. It is also desirable that the gases be split up and divided into as many narrow streams as possible.

WEIGHT ECONOMY.

We can now pass on to the second part of the paper, viz., conditions affecting the weight economy. The whole question of weight economy is mainly a question of what can be sacrificed. For instance, in express boilers for torpedo boats, large sacrifices must be made in order to get the highest possible duty with the minimum possible weight. In boilers for naval and mercantile purposes weight is still an important factor, whereas for land boilers it is of quite secondary importance. Saving in weight may be made in several directions, viz :—

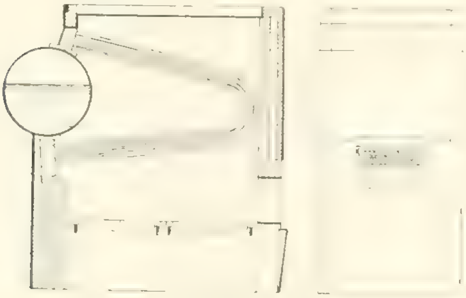


FIG. 6. SOLIGNAC BOILER.

(*a*) Reduction of heating surface.
(*b*) Reduction of scantlings.
(*c*) Reduction of water space.
(*d*) Reduction of steam space.

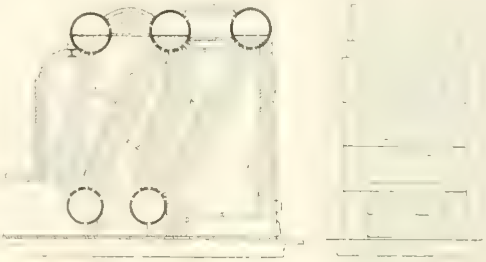


FIG. 7. STIRLING BOILER.

Reduction of the weight of the heating surface may be done in two ways, viz., by reducing the amount of the surface or by reducing its thickness. By reducing the amount of the surface, fuel economy has to be sacrificed; but a reduction of the thickness has the double advantage of keeping down the weight and increasing the thermal efficiency. Here again we see the advantage of the small diameter tube, and since vertical tubes can be of smaller diameter than horizontal, it follows that they will be more advantageous.

A reduction of scantlings involves a sacrifice of durability and of safety.

Large weight economies can be effected by reducing the water space, the sacrifice generally being that of accessibility. Here again the tube of small diameter has the advantage over one of larger diameter, for instance, two 2-in. tubes have the same surface as one 4-in. tube, but the 2-in. tubes only contain half the weight of water.

Weight economy may also be effected by reducing the steam space. A large steam space means drums of large diameter or length, and the temptation to reduce these is great. The inevitable result of reducing the steam space is to get wet steam. The ridiculously small steam space given to most water-tube boilers has

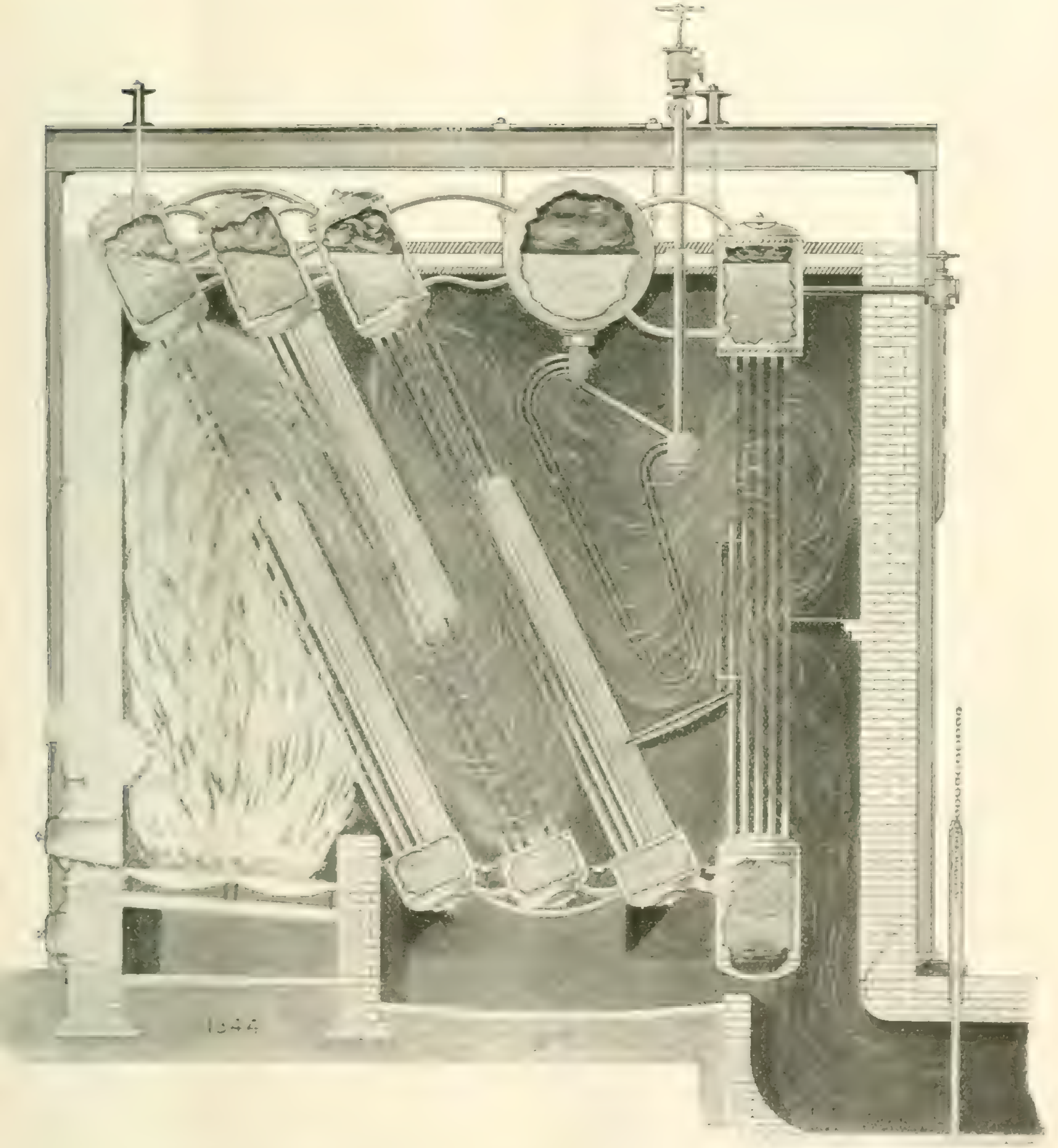


FIG. 8. STANDARD "NESDRUM" WATER-TUBE BOILER, WITH COMBINED SUPERHEATER
(HORNSBY'S PATENTS).

Manufactured by Messrs. Richardson, Westgarth, and Co., Ltd.

given the whole class a bad name for wet steam. One of the earliest of water-tube boilers—the Haystack boiler (fig. 10)—was designed with ample steam space, and no trouble is experienced with wet steam although the boilers are most invariably used in connection with paddle engines, which have an unenviable notoriety for inducing priming.

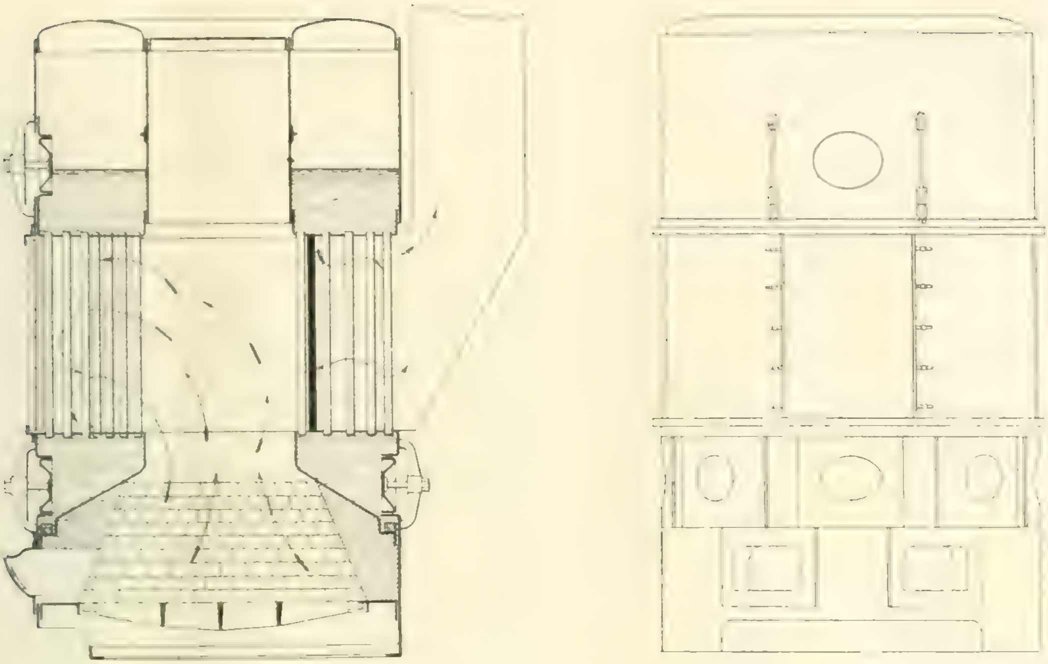
PRIMINGS AND WET STEAM.

The question of priming and wet steam is a very important one, as a most inefficient boiler, *i.e.*, a boiler which supplies a mixture of half steam and half water, may on test appear to have a better evaporative efficiency than a boiler supplying perfectly dry steam. The usual method of conducting boiler tests is to weigh the amount of water pumped into the boiler and assume that it is all evaporated into steam. There is good reason to believe that steam can carry in suspension from 10 per cent. to 15 per cent. of water and still appear " dry." As in the case of the combustion chamber, the shape of the steam space has an important effect on its efficiency. The surface of the water, owing to the circulation and the escape of the steam bubbles, is in a state of agitation, and jets of water are projected up into the water space. Hence what is required is a steam space having the maximum possible height above the water surface. In the case of the three-drum express boilers the extra weight and space which would be entailed by making the steam drum of sufficiently large diameter to give dry steam must be sacrificed. In most of the horizontal water-tube boilers the steam space is too small, and in all of them the height is too little to secure dry steam. Besides the Haystack boiler before mentioned, the only other boilers of the vertical tube type, which have a good steam space, are the Cummins' and the Fleming and Ferguson (fig. 11), in both of which the tubes are arranged to be withdrawn into the upper drum.

Coming now to the space economy, it is evident that the minimum space will be occupied by those types of boiler whose floor space is equal to the grate area plus the area of the containing walls, provided that the height is reasonable. In fact, for all boilers intended for marine use this space must not be exceeded to any extent. All the horizontal water-tube boilers, such as the Belleville, Niclausse, etc., have the desired minimum floor space. The Yarrow and Thornycroft type of boiler have a floor space equal to the grate area plus area of the lower drums, which does not much exceed the minimum mentioned above. Of the other vertical water-tube boilers, the Cummins' is the only one which has this minimum of floor space. We thus see that as regards weight economy the vertical-tube boiler should have the advantage, but that there is not much to choose between the two types as regards space economy.

CONDITIONS AFFECTING COST.

Passing on now to the third division of the paper, viz., conditions affecting the cost or capital economy. This is determined to a large extent by the weight and nature of the material used in the construction of the boiler, so that as a general rule the lightest boiler will be the least costly, that is to say, if the material used is of ordinary standard make. Outside of the question of weight, the constructive design of a boiler has the most effect on the cost. Flat stayed surfaces are probably the most expensive item in boiler work, and the great majority of water-tube boilers have none of this work, the exceptions being the flat headers of the Niclausse, Durr, and Hornsby. The cheapest method of securing the tubes in their places is apparently that of expanding. The screwed joints of the Belleville and the coned joint of the Niclausse certainly cost more than expanding the ends. The fire casings of water-tube boilers are also a very expensive item, especially when they have to be protected by tiles on the inside. All the three-drum boilers have expensive casings and a considerable area to be protected by tiles, and the same



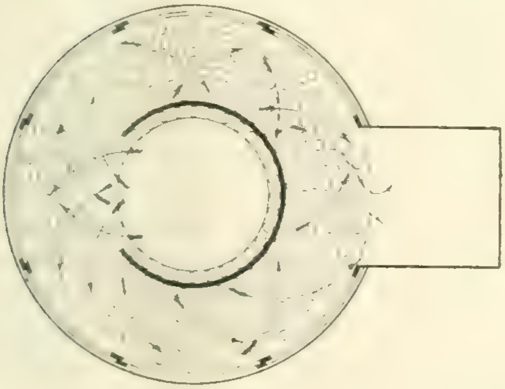


FIG. 9. CUMMINS' CYLINDRICAL WATER-TUBE BOILER.

remark applies to all the horizontal tube boilers. In the Cummins' boiler, the casings are not exposed at any point to the combustion chamber heat. The Stirling, Hornsby, Cahall, and Climax (fig. 12) boilers have brickwork casings and hence are quite unsuitable for use on board ship. We thus see that in the matter of cost economy there is not much to choose between the two types.

MAINTENANCE ECONOMY.

This brings us to the last division of the paper, viz., conditions affecting the working or maintenance economy, which includes all questions of accessibility for cleaning, facilities for repair and renewals, etc.

Taking, first, accessibility for cleaning purposes it is evident that access must be had not only to the internal parts of the heating surface, but also to the external parts. For adequate examination and cleaning, the very first necessity is of course straight tubes. If the feed water has the slightest tendency to deposit any impurities, the use of straight tubes should be insisted upon, as if any deposit takes place it can be seen and removed with certainty, which is not the case with curved tubes. The usual method of cleaning curved tubes is by a chain ; and the man sent into a drum of small capacity, with instructions to clean several hundred tubes, would be more than human if he did not leave some of them in their original state. Among the minor advantages of the straight tube is the feeling of confidence engendered when it can be examined from end to end, and incipient defects such as pitting or corrosion can be localised.

As regards actual cleaning or examination, there is not much to choose between the vertical and horizontal tube boiler; but the vertical tube has the immense advantage that scale cannot be so easily deposited in it as in the horizontal tube. This is due to two reasons; first, because the circulation through the vertical tube is more rapid and has a scouring action all round the tube; and, secondly, because when cooling down, any suspended matter in the water will not drop down through the vertical tubes, but will be deposited on the bottom of the horizontal tube. Other parts requiring internal access for cleaning are the tube plates and the steam and water drums. These parts, except in the case of some express boilers, are generally fairly accessible in most types.

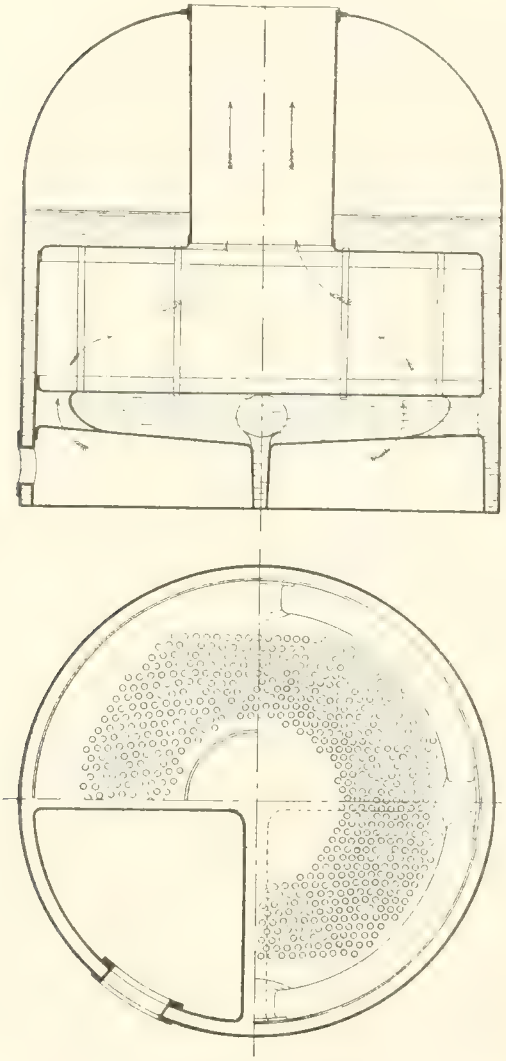


FIG. 10. HAYSTACK BOILER.

Coming now to the access to the external part of the heating surface, it is perhaps more important to provide means for keeping this part in a clean state than the internal parts. Deposit on the internal parts of the boiler can be prevented by several means, such as the use of a surface condenser, treating the feed water, etc. There is, however, no known means of doctoring the fuel to prevent it depositing soot on the external surfaces; hence the necessity for efficient means of removing it mechanically. Here again, as before, the vertical tube shows its superiority to the horizontal, as soot cannot grow on to a vertical tube to any appreciable thickness, whereas it can accumulate to a great extent on the top of a horizontal tube. The usual method of external cleaning is by a steam jet. This method is effective in getting rid of the dry dust and soot which may accumulate to some depth on the tubes, but it is not effective in removing the greasy adherent deposit which has such a bad effect on the heat transmitting efficiency. To remove this a wire brush is necessary, and provision should be made for conveniently working this when the boiler is under steam. The space available for this operation is restricted to the stokehold and the ordinary clear space round the boiler, say, 18 in. The use of a brush is practically restricted to the straight tube boiler, whether of the horizontal or vertical type. As, however, the tubes must be zigzagged, it follows that the brush can only be used in one direction, that is to say, it can only brush two sides of every tube.

A COMPARISON OF TYPES.

For instance, in the Yarrow boiler, the stacks of tubes could be brushed from the stokehold (if it were of sufficient length), but they could not be brushed in the other direction, *i.e.*, thwartships, as the zigzagging of the tubes would prevent it. The same remarks apply to the Babcock and the Durr boilers. The Belleville is peculiarly difficult to clean mechanically.

In the Cummins' boiler the tubes have been so arranged that each tube can be swept on four sides, thus cleaning practically the whole circumference of the tube and approximating to the cleanliness obtained by the tube brush in a fire tube. The tubes are arranged in concentric rows, and an equal number of tubes in each row. Each tube is also zigzagged with its neighbour. If this construction is followed out it will be found that the tubes form curved avenues through which a curved tube brush can be used. This curve approximates to an arc of a circle which has its centre in such a position that the brush when fully withdrawn projects only a very short distance radially from the boiler. As there are an equal number of tubes in each row and symmetrically arranged, the brush can be used in both a right hand and left hand direction, and then each tube can be brushed on four sides. Access is given to the tubes by sliding doors arranged in narrow sections, so that only a small portion is exposed to the inrush of cold air when sweeping.

We next come to the question of accessibility for repairs and renewals. Taking, first, the method of securing the tube ends in their plates or headers, the most usual practice is to expand the tube ends. Notable exceptions are the screwed joints of the Belleville, the conical joints of the Niclausse, and the Reed joint. Taking everything into consideration, the

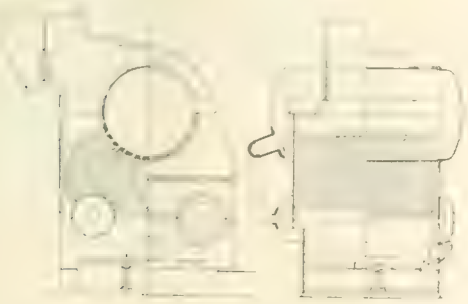


FIG. 11. FLEMING-FERGUSON BOILER.

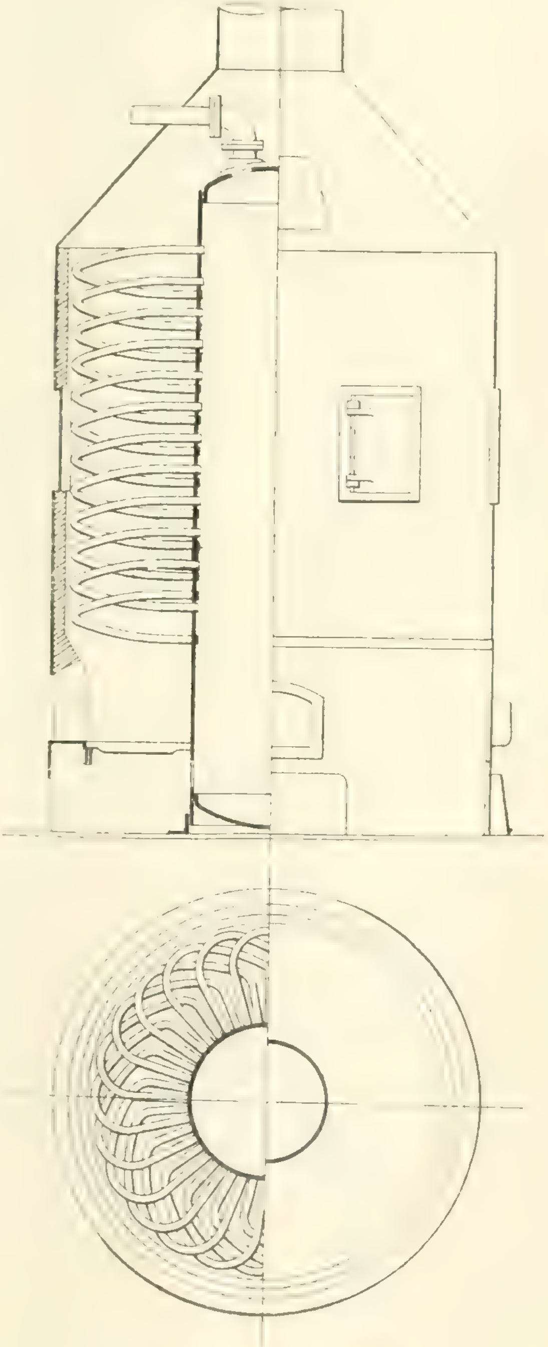


FIG. 12. [illegible] BOILER.

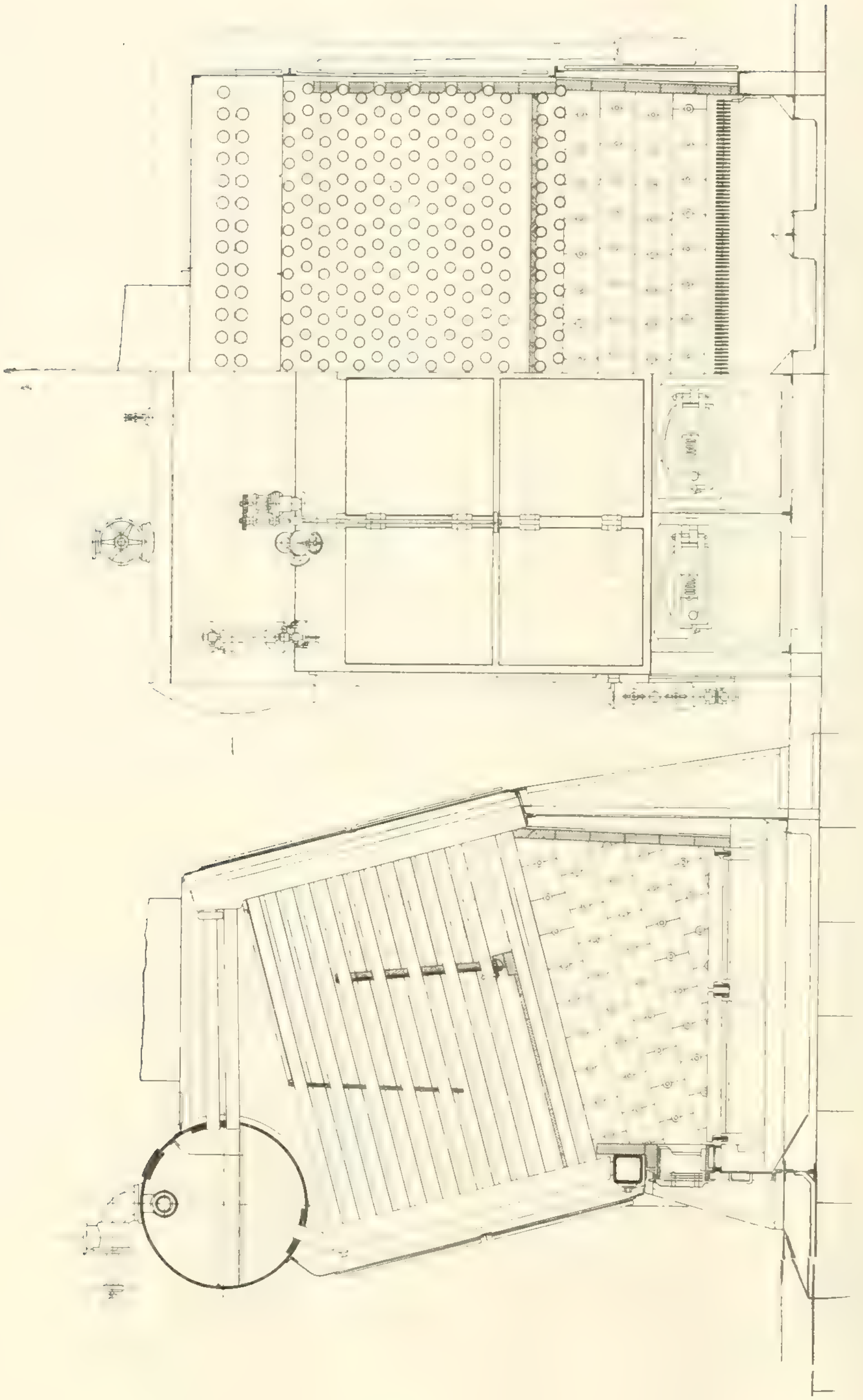


FIG. 15. TYPE OF BABCOCK AND WILCOX WATER TUBE MARINE BOILERS.

As fitted in the Royal Navy.

expanding method seems to give the best and most practical results. If an expanded tube end does leak, it can always be touched up with the expander; whereas if any of the screwed ends of the Belleville leak—well, they have got to leak until the element is pulled out on the stokehold floor and repairs can be made.

Next, as regards renewing defective tubes, most of the horizontal-tube boilers are well adapted for effecting this easily and expeditiously in the case of a pinhole leak or some such minor defect. As, however, the horizontal tube is so liable to become overheated and bulged or burst, it becomes impossible to withdraw the damaged tube, through the tube plate, and the only way of getting it out is to cut out some of the good tubes in its vicinity. Most of the express boilers have to renew defective tubes by cutting out good ones, the notable exceptions being the Blechynden (fig. 18) and the Reed boilers. There is also another vertical-tube boiler which has the same defect, viz., the Stirling. In the Cummins' boiler the damaged tube can be withdrawn into the upper drum, and there is ample room to get at both ends of the tube for cutting, and for using the ordinary standard expander. This same advantage is possessed by the Fleming and Ferguson boiler.

Another important point is to provide sufficiently good access so that every riveted joint may be recaulked both inside and outside. Most of the water-tube boilers of both types allow for this, although in the majority of the express boilers the space for working is very cramped.

UPKEEP OF BRICKWORK AND FIRE CASING.

The upkeep of brickwork is in some cases a rather heavy item, especially where an intense heat has to be resisted by thin firebricks hung on to vertical plating. The wear and tear on thick brickwork about the level of the firebars is not so much as would be expected and can easily be repaired by ordinary stock firebricks. When, however, vertical plating has to be protected the fireclay tiles have to be secured in some way to the plating, and it is this which causes so much trouble. Many of the vertical and horizontal types of boilers suffer equally from this defect. For instance, the Yarrow boiler has the two triangular ends exposed to the full heat of the combustion chamber, and the Babcock marine boiler has the side casings below the level of the first row of tubes exposed to the full heat of the furnace. In some types with bent tubes an attempt

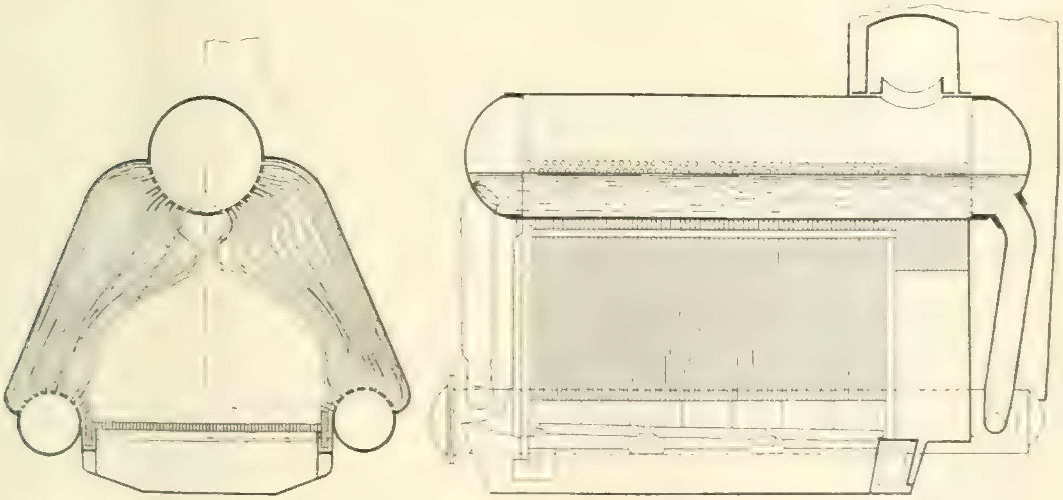


FIG. 12d. NORMAND BOILER.

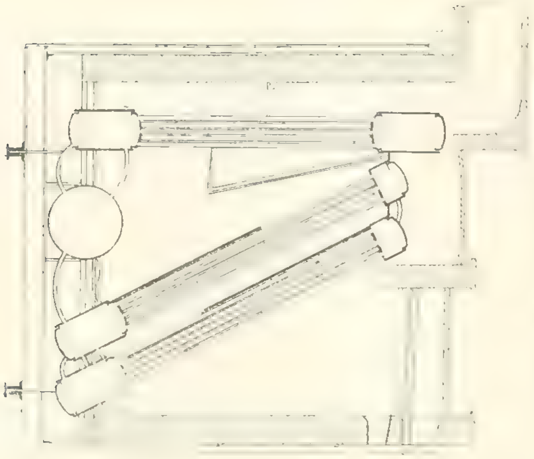


FIG. 16. HORNSBY BOILER.

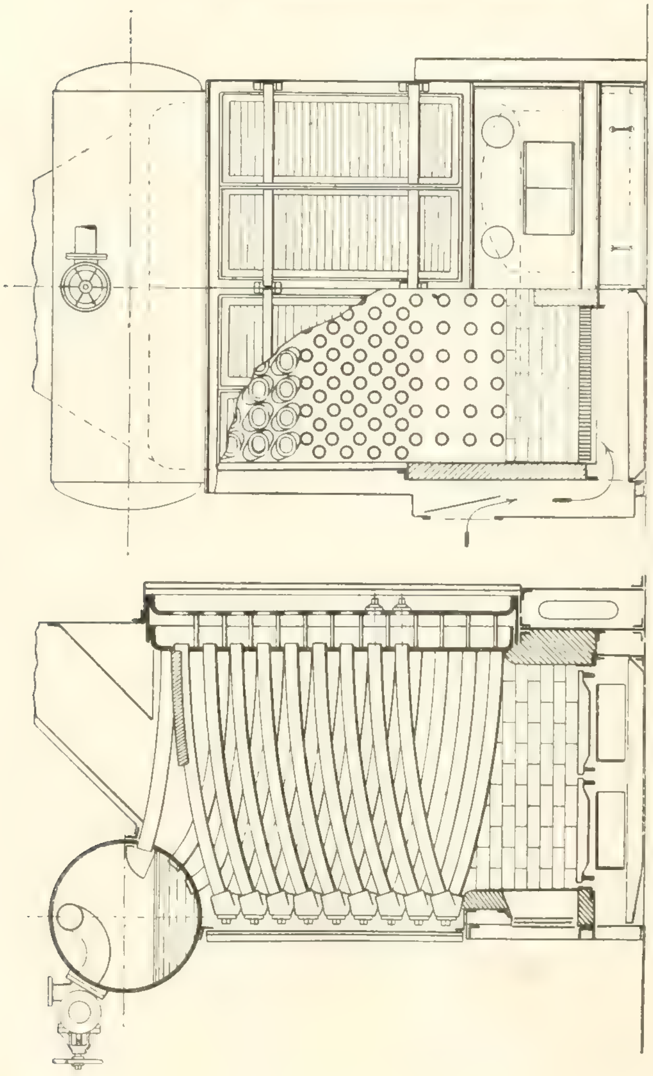


FIG. 14. THORNYCROFT-MARSHALL BOILER.
In course of construction.

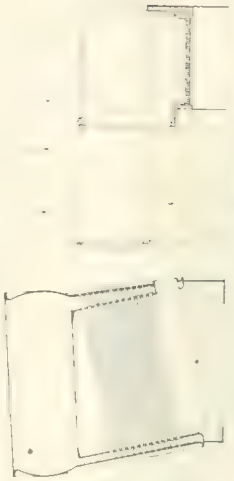


FIG. 19. LAFRAGEL D'ALLEST BOILER.

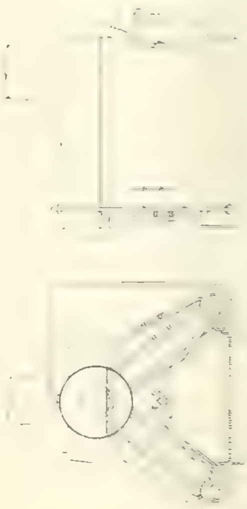


FIG. 18. BLECHYNDEN BOILER.

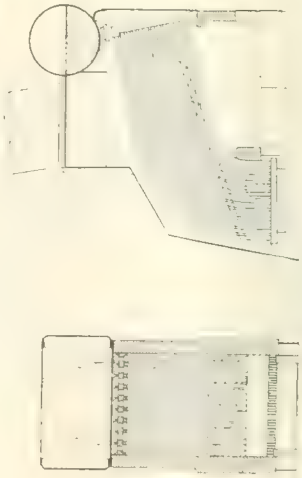


FIG. 17. HAYTHORN BOILER.

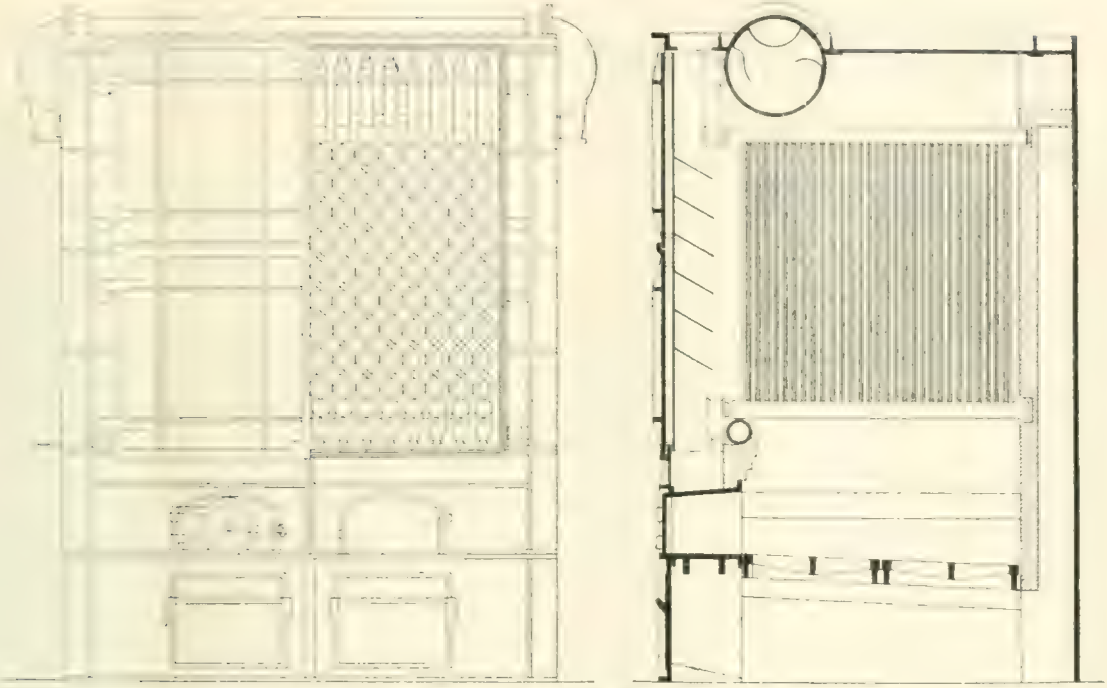


FIG. 13. HAMPSON BOILER.

is made to cover up these exposed parts by a single bank of water tubes.

This brickwork, however, must tend towards assisting good combustion. For instance, in the Stirling and Hornsby (upright) boilers there is a large mass of brickwork which absorbs a large amount of heat when the fire is clear and part of this is available to heat up the cold gases given off a green fire. Although, however, this mass of brickwork is an advantage to a boiler which is continuously at work, it is a serious disadvantage when intermittent work is required, as, after the boiler is shut down, the large amount of heat stored in the brickwork continues to evaporate the water in the boiler and cold water has to be pumped in long after firing has ceased. In the Cummins, boiler the furnace is lined with thick firebricks, the combustion chamber is entirely surrounded by water tubes, the sliding doors, being only exposed to comparatively cold gases, do not need a fireclay face; they are made of two thicknesses of plate filled in with asbestos.

This completes the review of the four conditions neecessary to make a commercially successful boiler and the balance of advantages appears to the writer to be with the vertical-tube boiler. This is to a great extent confirmed by the last report of the Boiler Committee, who give most praise to the Yarrow boiler. The choice of a boiler, however, must depend entirely on the conditions required in each particular case. On a torpedo-boat everything must be sacrificed to weight and space economy. On a battleship or cruiser weight and space are still important, but sacrifices must be made to fuel economy and working economy. On a liner fuel economy and working economy are paramount. On a tramp steamer cost economy is most important. In all cases, however, fuel economy is a vital point and unless a boiler is, *per se*, economical in fuel it will not in the end be able to compete with other boilers of superior economy, however, many other virtues it may possess.

Read before the North-East Coast Institution of Engineers and Shipbuilders.

THE WEEK AMONG THE TECHNICAL SOCIETIES.

INSTITUTION OF ELECTRICAL ENGINEERS.

ANNUAL DINNER.

THE annual dinner was held on the 2nd inst. at the Hotel Cecil.

Mr. Alexander Siemens, the President, presided, and among those present were Lord Strathcona, Lord Alverstone, Mr. C. E. Spagnoletti, Professor W. E. Ayrton, F.R.S., Lord Biddulph, Sir E. H. Carbutt, Sir Marcus Samuel, Colonel R. E. Crompton, R.E., Sir H. Buckley, Professor S. P. Thompson, F.R.S., Rear-Admiral Sir A. J. Durston, Mr. R. Hammond, Major-General Sir A. E. Turner, Sir C. Fremantle, Sir A. Noble, Sir J. Norman Lockyer, Sir J. Wolfe-Barry, F.R.S., Professor J. Perry, F.R.S., Sir William Abney, F.R.S., Sir W. Ramsay, F.R.S., Sir C. Hartley, Sir G. Birdwood, Sir P. Magnus, Mr. J. Gavey, C.B., Sir R. Hunter, Sir James Dewar, F.R.S., Sir H. C. Mance, Captain H. O. Mance, R.E., D.S.O., Sir W. Lee-Warner, Mr. J. E. Kingsbury, the Dean of Westminster, Colonel Sir H. Jekyll, Sir Douglas Fox, Mr. W. M. Mordey, Mr. W. S. Prideaux, Sir A. B. Binnie, Sir A. W. Rücker, F.R.S., Mr. William I. Buchanan, Sir J. W. Swan, F.R.S., Mr. R. Kaye-Gray, Mr. W. H. Patchell, Mr. R. Robertson, Mr. S. Z. de Ferranti, Mr. J. S. Highfield, Mr. J. Swinburne, Mr. S. Dobson, Mr. C. D. Taite, Mr. C. B. Sparks, and Mr. J. S. Haworth.

Lord Alverstone gave the toast of "The Institution of Electrical Engineers." He asked them to think of what that Institution was some thirty-five years ago, when some seven eminent telegraph engineers combined to start the Society of Telegraph Engineers, doubting whether it would find a place among the scientific institutions for very long, questioning whether there was a sufficient force behind them to enable them to maintain a separate organisation. They saw what it was to-day—one of the most successful, one of the best supported, and one of the most powerful scientific organisations among the scientific societies now existing. And to what was that due in large measure? It was due to the fact that that institution had kept pace with the times, had been the first to promulgate and promote among its members all the information about electrical science that could be obtained, had been willing to welcome electricians from all parts of the world, had kept its students and its members acquainted with every modern development, and had given them the means of cultivating the technical knowledge of their science to the highest extent. He need not remind them what extraordinary things had happened in the short life of that institution. He would not remind them except in one sentence, of the marvellous development of electrical communication by means of the telephone. Then came the extraordinary development of electric lighting, of which they did not see a very successful illustration that night, and during the last ten years there had been the marvellous development for the transmission of power extending in some parts of the world over hundreds of miles. What would happen before the Society attained its jubilee? No one could say, but it was certainly to the younger members a matter of great congratulation that they were members of a Society which, though it claimed but thirty-five years of existence, still had been able to number in its ranks all the distinguished electrical engineers, and many others who were interested in the development of electrical science. The previous day saw two of the distinguished past presidents of that institution gaining fresh honours. Sir William Crookes, as they knew, was awarded the Copley medal of the Royal Society, and their friend Sir Joseph Swan, who was there that night, was the recipient of the Hughes medal. Sir Joseph Swan had been recently honoured by His Majesty the King, and no man in England had more worthily won his distinction, too long, he thought, delayed, but now felt by everyone to be richly deserved as had been worthily won. Their President bore a name which would be for ever connected with that institution. Sir William Siemens was among the first founders of the Society of Telegraph Engineers, to whom in no small measure the success of their institution was due.

The President, in responding to the toast, said he would continue the list of honours, to which Lord Alverston had referred, which had been granted to the members by reminding them that Lord Kelvin, one of their oldest past presidents and the nestor of their profession, had attained the dignity of Chancellor of the University of Glasgow. The President proceeded to announce that telegrams of congratulation and sympathy had been received that evening from the Belgian and Italian Societies of Electrical Engineers. In their visits to foreign countries the international character of electrical engineering had come out, and it was this which had contributed not a little to the development of electricity throughout the world.

Mr. Robert Kaye-Gray proposed "Our Transatlantic Kinsmen," and the toast was responded to by Lord Strathcona (High Commissioner for Canada) and Mr. William I. Buchanan (managing director of the British Westinghouse Company).

Mr. Robert Hammond, hon. treasurer, gave the toast of "Our Guests," to which Sir Henry Buckley responded.

MANCHESTER STUDENTS' SECTION.

ELECTRIC POWER IN MACHINE SHOPS.

A paper on this subject was read by Mr. H. C. Jenkins before the Manchester students' section of this Institution on the 25th ult., of which the following is an abstract :—

The system of driving may, of course, be either by direct or alternating current, and in many cases a combination is advantageous. The old installations are almost without exception constant-speed, and are arranged for group drive. The constant-speed motor generally used is a shunt wound machine, but the modern tendency seems to lean towards "direct drive," and in most cases it is advisable to have a well-designed motor for variable speeds. The old mode of varying the speed was by the rheostatic method, which is extensively used with cranes, and is particularly well adapted for series motors or intermittent service. It is, however, in the main an inefficient method.

Another method of applying a variable speed is by means of a balanced three-wire system, the advantage of this method being that, if well designed, the neutral wire need only be comparatively small, as it has only to carry the weight of balance current. With an ordinary two-wire system, a speed change of about 2 to 1 can be obtained ; in a three-wire it is approximately 4 to 1.

There are several multi-voltage systems, all consisting of a number of circuits working at different voltages. These voltages are supplied either by an auxiliary booster or by a balancer set. The objection to this system is the complication of the generating apparatus and the wiring.

Another matter which must be considered in the choice of variable speed motors for certain classes of work is, that a large speed variation produced by motors alone (where uniform power is required) not only adds materially to the cost of the equipment, but lowers the efficiency of the drive and increases the space occupied by the motors. So that a mechanical, speed variation for obtaining a few changes of speed at wide ranges would be advisable, and the electrical system would give any intermediate speed required.

ALTERNATING OR DIRECT-CURRENT SYSTEMS.

The alternating-current system is not so conveniently applicable as the direct current for speed variation within small limits. This system has great possibilities, but at the present stage it is only applicable to large or widely distributed plants. In the alternating current system, there is not the flexibility of multi-voltage systems, as the speed of the synchronous and asynchronous motor depend primarily upon the frequency and not upon the voltage of the circuit ; therefore, they are constant-speed motors, as it is not practical to vary the frequency.

Two or three-phase systems are at present the only ones extensively used for power purposes, and they have been much more adopted in America and the Continent than at home. This is probably due to the number of polyphase transmission plants in operation. The frequency of the circuit should be kept as low as possible, because the higher the frequency the lower the power factor of motors, and, therefore, the larger will be the lagging currents, causing out of balance currents in the system.

There has been a great deal of prejudice against the induction motor owing to its supposed inadaptability for variable speed work, as cranes, hoists, etc. and to its low efficiency. With motors of more than 30 h.p. the comparisons are as follows : A direct current motor can be obtained with a better full-load efficiency and starting torque, but the induction motor is lighter, has a better medium and light load efficiency, and has an incomparably better overload capacity. The maintenance operation and depreciation costs are extremely low. In practice there are many advantages to be claimed for the induction motor.

The induction motor has been used with a great deal of success for driving portable machine tools. Alternating-current motors are now extensively used for crane work. They work smoothly, are easily controlled, and their starting torque is higher. The more usual type is, however, the direct-current series motor.

Single-phase motors of the repulsion series, and other types, will probably in the future occupy an important position in machine driving, and may eventually substitute the direct-current motor for variable-speed work.

In alternating current plants it is sometimes found necessary to instal direct-current generating apparatus where alternating current cannot be used. A rotary converter is usually installed, but in some cases double-current generators have been utilised.

SOCIETY OF ENGINEERS.

CONDENSING MACHINERY.

At a meeting held at the Royal United Service Institution, Whitehall, on Monday evening last, Mr. D. B. Butler, President, in the chair, a paper was read on "Condensing Machinery," by Mr. William Edward Storey, and of which the following is an abstract :—

The author observed that the jet condenser, from its simplicity was mainly used until the demand for pure feed-water became imperative, and the surface condenser was introduced into steamships. The originating cause of the independent condenser was the high speed of modern reciprocating engines. A comparison of the relative advantages of different types of jet condensers showed the counter-current condenser to be more efficient than the parallel current type, producing a better vacuum with reduced expenditure of power and smaller outlay for pumps. The barometric condenser, he observed, dispensed entirely with the air pump, and he gave particulars of a large installation of such condensers in Manchester. A similar condenser invented by Weiss, used the barometric principle in conjunction with a dry air pump. The design of water pump best suited for use with counter-current condensers was stated to be the horizontal, in which type particular care has to be observed to prevent accumulation of air in the valve boxes.

TYPES OF CONDENSERS

The author observed that the best-known types of the ejector condenser included those of Morton, Korting, and Ledward, and they differed not greatly in principle, though considerably in detail. They were water-jet pumps abstracting the air inductively. In most cases a pressure water supply was absolutely necessary for installations of this type of condenser.

The question of pure feed-water was the genesis of the surface condenser, the oil separator or filter freeing the water of condensation from the only impurity likely to have ill effects upon the boiler. Jet condensers were more efficient, but could not be applied in all cases. The author observed that the evaporative condenser enabled the advantages of surface condensation to be experienced where there was only sufficient water available for boiler feed purposes. It schief drawback was the fouling of the cooling surface by sedimentary deposit.

Various attempts have been made to improve the efficiency of the tubular condenser by bringing the water and steam in closer contact. Wheeler uses an internal return tube for the cooling water. Paul blocks up the centre of the condenser tube forcing the water through an annulus and the steam through an outer annulus, thus minutely subdividing both bodies. A condenser with corrugated plates for cooling surface, the invention of a Swede, Ljungstrom, is, by reason of its novelty, worth detailed notice.

Thin brass plates corrugated at an angle of 45 deg. form the cooling surface (fig. 1), and as they are piled together to form the unit, the plates, which are adjacent to each other, have the corrugations running in reverse directions. This simple expedient gives ample support to the flat plates, and renders any further staying to provide resistance to the atmospheric pressure quite unnecessary. It will also be seen that this arrangement of the corrugations causes the streams of steam and water to be broken up, exposing each in turn to a more intimate contact with the conducting medium. The proper spacing of the plates is effected by brass frames placed between each plate and serrated in turn on what may be termed the end and side edges. These serrations or grooves form the inlet spaces for the steam and water respectively. When the plates and frames forming the complete unit have been assembled, cramping plates and through bolts bring the jointing surfaces together and a perfect joint is secured by means of strips of paper soaked in oil.

Such a complete unit is shown in fig. 2, and the perfect soundness of the joints has been placed beyond question by many severe tests under working conditions.

This type is capable of condensing 70 lb. of steam per square foot per hour. The saving in weight resulting from the use of one of these condensers in a torpedo

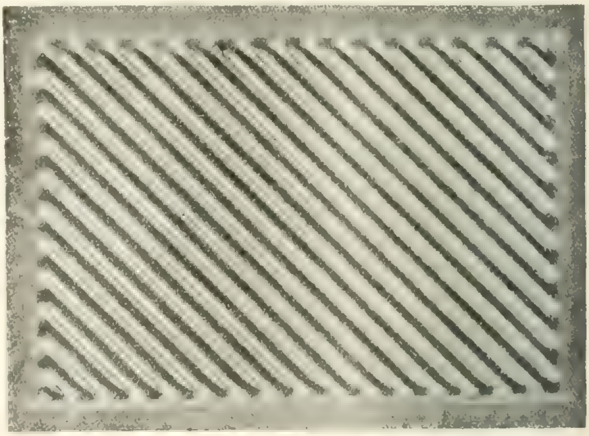


FIG. 1. LJUNGSTROM SURFACE CONDENSER.
The Cooling Surface.

heat was stated to be [illegible] per cent. as compared with the tubular type of condenser. For tubular condensers the best arrangement for the tubes was stated to be the vertical, which gives better drainage for the water condensed on the surface and leaves the latter more efficient.

TYPES OF PUMPS.

The author stated that air pump capacity varied for surface and jet condensers in about the ratio of 0·7 to 2·0 cubic feet per lb. of steam per hour. Of vertical single-acting types the Edwards pump is largely used. It is provided with only one set of valves, head-valves, and the air and water enter the working barrel through ports. The form of the bottom end of the pump chamber causes the water to be violently injected into the barrel carrying air with it, both to be discharged on the up-stroke. A very similar pump was designed in 1845 by J. G. Bodmer, and later modifications employ the same principle of valveless suction end.

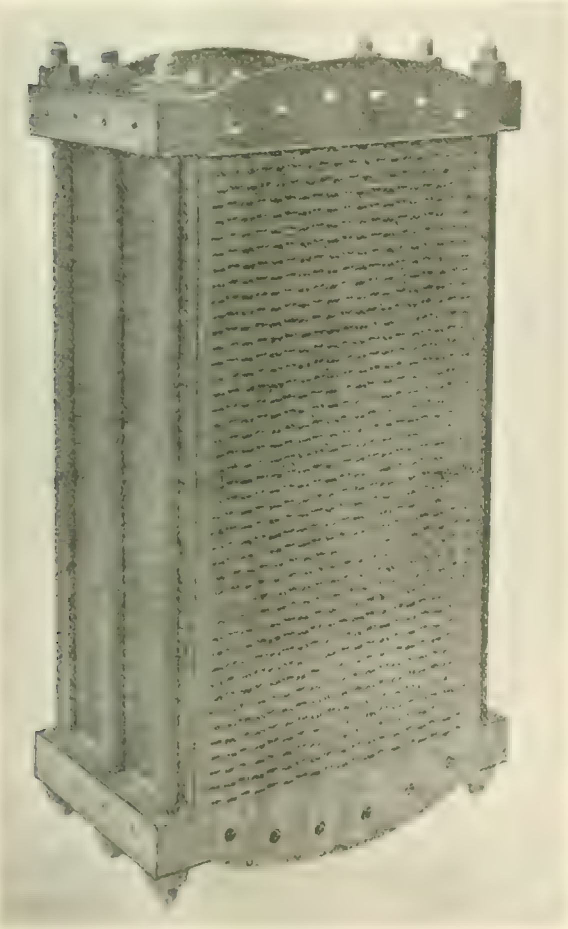


FIG. 2. LJUNGSTROM SURFACE CONDENSER.
A Complete Unit.

Slide-valve air pumps, to be used dry, were referred to as becoming more common, having proved themselves efficient by wide application on the Continent. Two-stage dry air pumps are also being employed for high vacuum in connection with turbines. For the same class of duty vacuum augmenters are used by some makers. Parsons employs an auxiliary steam jet to compress the air on the suction side of the air pump.

The circulating pump best suited for constant duty under moderate lifts was said to be of the centrifugal type, but the author pointed out that reciprocating pumps were better for a varying load and high lifts. The cooling tower was referred to as enabling condensing plant to be utilised independently of any considerations of large natural water supply. Cooling towers effect their object by the evaporation of water of 75 to 90 per cent. of the weight of steam condensed.

Central condensing plants are used where many different units of steam engines are installed, and are generally operated by their own steam engines or by electric motors. At Deptford, condensing plant for 10,000 h.p. of engines is erected on the roof, and contains some points of novelty in design. It consists of cooling towers, surface condensers, air and circulating pumps with their own high-speed engines. In conclusion, the author observed that the difficulties met with in dealing with condensers for winding and similar intermittently working engines had still largely to be solved, but were now receiving much attention.

JUNIOR INSTITUTION OF ENGINEERS.

TORPEDO-BOAT CONSTRUCTION.

At a meeting held at the Westminster Palace Hotel on Friday last, Mr. Harold E. Yarrow read a paper entitled "Some Points of Interest in Torpedo-Boat Construction." The chairman of the Institution, Mr S. Cutler, presided.

Mr. Yarrow said that one of the most important considerations in the design of a torpedo-boat was how to realise the maximum strength with the minimum weight. It was essential, therefore, to design the hull so as to obtain uniform elasticity throughout its length. Care should also be taken to avoid sudden changes of section, otherwise severe bending would arise locally, instead of being distributed over a greater length, and consequently would be more trying to the metal.

It was of the greatest importance to minimise vibration. It had been proved that a properly balanced propeller did not cause vibration, provided there was no play in the stern shaft bearings. Attention, therefore must be turned to the machinery, which was the true source of vibration, the cause being that the reciprocating parts were not properly balanced. Too much consideration could not be given to steam pipes in torpedo-boat construction. It had been found by actual experience in the present war that one of the greatest dangers to the vessel was the chance of the steam pipes being hit by the enemy's shot, causing serious leakage, and rendering the engine-room and stokehole impossible of occupation. There were many advantages in the turbine over the reciprocating engine, but it could not be said that it had proved economical for varying speeds, and, while it was suitable for vessels travelling at a uniform maximum speed, in the case of a torpedo-boat, the speed of which was constantly varying, the reciprocating engine was more economical. By the use of that comparatively new type of engine, the explosive engine, in a torpedo boat, great advantages were obtained.

The following Presidential addresses have been delivered in connection with local branches of the Institution of Electrical Engineers: Dublin section, Mr. Mark Ruddle; Manchester section, Mr. C. D. Taite; Newcastle section, Mr. Eugene Booth.

At a recent meeting of the Leeds University Engineering Society, Mr. G. H. Attock brought forward the subject of "French Foundry Practice." He stated that while English foundry masters more than held their own with regard to heavy castings, France and Germany excelled in the production of small or intricate castings. This was especially noticeable in work for the motor-car and motor-cycle trades. The predominance was, he thought, due to the extensive and intelligent use of moulding machines in foreign foundries.

A paper has been read at the Rugby Engineering Society, "Some Notes on High-Speed Electric Railway Work," by Mr. F. W. Carter.

At the last meeting of the Dundee Society of Experimental Engineers, Mr. W. C. Martin, Glasgow, delivered a lecture on "Electrical Appliances."

LAUNCHES.

On Wednesday last the s.s. *Branksome Hall*, which has been built by Swan, Hunter, and Wigham Richardson, Ltd., Wallsend-on-Tyne, for the Hall Line service of the Ellerman Lines, Ltd., was taken out to sea for her trial trip. The dimensions of the vessel are: Length over all, 386 ft.; beam extreme, 46 ft. 8 in. by 30 ft. 5 in., depth moulded. The vessel has been designed to carry a deadweight cargo of about 6,900 tons on a moderate draught of water. The machinery has been constructed by the Wallsend Slipway and Engineering Company, Ltd., and consists of a set of triple expansion engines having cylinders $23\frac{1}{2}$, 40, and 69, in. with 48 in. stroke. The speed attained on the trial trip was $11\frac{1}{4}$ knots.

There was launched from the yard of Earle's Shipbuilding and Engineering Company, Ltd., Hull, on November 28th, a steel twin-screw cargo steamer named the *Clacton*. Her dimensions are: Length, 245 ft., beam, 31 ft., depth of hold 15 ft. She has a long poop, bridge and topgallant forecastle, fitted out for the carrying of horses and cargo. The holds are ventilated by powerful fans, for the safe carrying of perishable goods. There are three large hatches, two masts with derricks, three steam winches and a steam crane; all these are arranged to give rapid handling of cargo. The vessel is to be fitted with patent steam tiller and telemotor gear by Messrs. Brown Bros., Edinburgh. She will be propelled by twin-screw engines of the three-crank triple-compound type, having cylinders $15\frac{1}{2}$ in., $25\frac{1}{4}$ in., and 41 in. diameter respectively, with a common stroke of 36 in. The boilers are to be two in number, 13 ft. 3 in. diameter by 11 ft. 6 in. long, working with forced draught under a pressure of 180 lb. per square inch.

The *Mamari*, a new steamer of about 7,000 tons gross register, built by Messrs. Harland and Wolff, Ltd., to the order of Messrs. Shaw, Savill, and Albion Company, Ltd., for their New Zealand trade, left Belfast harbour a few days ago on its first voyage. The length of the *Mamari* is 455 ft., breadth 56 ft., and depth 34 ft. 9 in., and she is propelled by twin screws, the machinery consisting of two sets of quadruple expansion engines, which have been constructed in the builder's works. There are five holds, three of them being insulated for the carrying of frozen mutton, and the other two for general cargo. A complete installation of refrigerating machinery has been provided. All the most improved appliances for working the ship and rapid loading and discharging have been provided, including steam windlass, steam steering gear, and thirteen steam winches.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts

CONTRACTS OPEN.

	Last Day.
Craiova (Roumania).—Supplying and laying water cast-iron pipes for the town administration. Le Maire de la Ville de Craiova ...	Dec. 10
Fulham.—Supply and erection of a 3,000 volt steam alternator of 1,000 k.w. capacity at Townsmead Road generating station. Mr. R. M. [illegible], Town Clerk	Dec. 20
Manchester.—Supply of switchboards, mains, feeders, arc lamps, etc., in connection with the new dock works at Salford. F. A. Eyre, Secretary, Manchester Ship Canal Co., 41, Spring Gardens, Manchester	Dec. 22
East Indian Railway.—Supply of spiral and volute springs, and 150 ft. deck spans for bridges. Mr. C. W. Young, Secretary, Nicholas Lane, London, E.C.	Dec. 14 and 21
Alexandria.—Erection of a lighthouse on the Sanganeb Reef, Red Sea. Deputy Controller-General, Ports and Lights Administration, Alexandria ...	May 1
Bombay, Baroda, and Central India Railway.—Supply of stores, including spiral and volute springs, steel boiler tubes, steel rails, cast-steel wheels, steel fish-plates, etc. The Secretary ...	Dec. 21
London County Council.—Installation of heating, ventilating, and hot-water plant at Long Grove Asylum, Epsom	Jan. 23
Cuckfield.—Supply and delivery of cast-iron water mains, for the Council. Mr. D. Rankine, waterworks engineer ...	Dec. 16
Southend-on-Sea.—Supply of two boilers, steam dynamo, fuel economiser, and two electrical feed pumps, for the Corporation. Mr. W. H. Snow, Town Clerk	Dec. 21
Swindon.—Supply and erection of one 300 k.w. steam dynamo, or alternating one 400 k.w. steam dynamo. Mr. J. S. Griffin, Electricity Works, Swindon	Dec. 20
Cardiff.—Supply of plant for extensions to electrical power station on the extra high-tension three-phase system, including two engines, two alternators, four Lancashire boilers, etc. Mr. T. L. Wheatley, Town Clerk	Dec. 19.
Middlesbrough.—Supply and erection of pipe work and valves. Mr. A. Sockett, Town Clerk	Dec. 17
Spain.—The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until December 12th for the establishment and working of a telephone exchange in the town of Talavera de la Reina (Toledo province). Particulars from La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid	Dec. 12
Bradford.—Supply of miscellaneous stores required by their tramways department during year ending December 31, 1905. Mr. Frederick Stevens, Town Clerk ...	Dec. 17
Glasgow.—Supply of 100 motor equipments and spare parts for the Corporation Tramways ...	Dec. 22
Erith.—Supply of motor-cars, trucks, motors and equipments, etc. Mr. Charles H. Fry, Clerk to the Council...	Dec. 19
Ceylon.—To undertake and provide motor-car services for the conveyance during a period of ten years from July 1, 1905, to June 30, 1915, of mails and passengers by motor-car between (1) Bandarawela and Badulla, twice daily each way; (2) Badulla and Batticaloa, once daily each way; (3) Matale and Trincomalee, once daily each way; (4) Colombo and Chilaw, twice daily each way; (5) Chilaw to Puttalam, once daily each way. Crown agents for the Colonies, London; or Colonial Secretary, Secretariat, Colombo	Feb. 1
Ilford.—Installation of telephone fire alarm system for the District Council. Mr. H. Shaw, Town Hall, Ilford	Dec. 19

COMING CONTRACTS.

Bethnal Green.—The electric lighting scheme has now been definitely decided upon, and is estimated to cost £75,000.

Southend.—An inquiry has been held into the application of the Council for sanction to borrow £56,000 for electric lighting purposes.

Barnsley.—An inquiry has been held into the application of the Council for permission to borrow a further sum of £60,011 for the completion of the Midhope reservoir.

Douglas, Isle of Man.—A committee has been formed and is dealing with the proposal to spend £175,000 in enlarging the harbour.

Bournemouth.—A sum of £60,000 is to be spent in connection with a tramway to Swanage.

North Lincolnshire Railway.—Notices have been deposited with all the local authorities in connection with this electric light railway scheme. The estimated total cost is £586,000.

Hampstead.—The Borough Council has received the sanction of the L.C.C. to the borrowing of £27,340 for electric supply purposes.

Cardiff.—The Corporation proposes to borrow £87,868 for electric supply extensions.

London United Tramways.—This Company will shortly commence the construction of the whole of the authorised lines, fifteen miles in extent, in Kingston, Surbiton, the Dittons, Molesey, New Malden, and Wimbledon. The construction cost will be about half a million sterling.

Shanghai River Conservancy.—River conservancy works are to be carried out by the Chinese Government under the supervision of the Maritime Customs.

CONTRACTS CLOSED.

Marylebone.—The Electric Supply Committee has placed a provisional order with the Reason Manufacturing Company for the purchase and fixing of 5,784 maximum demand indicators for £13,847.

Hackney.—The Electric Supply Committee has provisionally placed the following orders: Demand indicators, the Reason Manufacturing Company, Ltd., 250, thermal type, at schedule prices; Schattner Electricity Meter Company, Ltd., 250, magnetic type, at schedule prices; air compressor, Messrs. Reavell and Co. (British Thomson-Houston motor), £83 9s. 6d.; arc lamps and pillars, Messrs. Johnson Phillips, £009 5s.

Dalmuir.—At the new shipbuilding establishment at Dalmuir of Wm. Beardmore and Company, Ltd., there will shortly be erected two very large weighing machines for weighing railway wagons, etc., the contract for which has been awarded to Henry Pooley and Son, Ltd.

Baker Street and Waterloo Railway.—The American Car and Foundry Company who have acquired a site in Trafford Park, Manchester, for the purpose of erecting large works for the manufacture of railway wagons and carriages. The company has just undertaken a contract for the supply of the railway carriages for the Baker Street and Waterloo Underground Railway in London.

London.—Gwynne's, Ltd., of Hammersmith Iron Works, W., have obtained an important contract for the supply of irrigation pumping machinery, to be used in connection with cotton growing in the Soudan.

Castleford.—A. Hirst and Son, Ltd., of Crescent Works, Dewsbury, have secured an order for an electric generating and haulage plant, to be installed at the Wheldale Colliery, Castleford. The plant comprises a 150-k.w. dynamo direct-coupled to a high-speed vertical engine, two 60 h.p. motors and one of 24 h.p. two hauling gears, and over three miles of heavy cables.

Nailsworth.—H. J. H. King and Co., Newmarket Engineering Works, Nailsworth, Gloucestershire, have received three further repeat orders for their patent friction clutches for electric haulage engines.

Thornaby-on-Tees.—Head, Wrightson, and Co., Ltd., have lately completed a contract for large coal-screening plant for the Dalton Main Collieries Company, Ltd., at their Silverwood Colliery.

Birmingham.—The British Electrical Engineering Company have received an order for 80 regenerative tramway motors.

North Shields.—The Tynemouth Corporation has accepted the tender of Siemens Bros. and Co., Ltd., for 600 k.w. Siemens-Belliss set at a price of £4,241.

London.—Messrs. Mackay Brothers, of Alloa, have just received an order from the Shipping Agency, Ltd., London, for two steamers, each about 140 ft. long.

Tipton.—Joseph Wright and Co., Tipton, have received orders for Berryman patent feed-water heaters from the Bradford Dyers' Association for the Bridge-street Dyeing Company, Ltd., and for the Standish Company, Ltd., of Standish Works.

London Underground Railways.—Messrs. John Macdonald and Sons, Glasgow, have received an order for a complete pneumatic equipment of cars—including four Ingersoll-Sergeant air compressors and 125 Haeseler pneumatic hammers, and drills and all accessories.

APPOINTMENTS VACANT.

	Last Day.
Admiralty.—Assistant Civil Engineers.—An Open Competitive Examination will be held on January, 1905	Jan. 5
Walthamstow.—Electrical engineer and tramway manager, to take charge of electric lighting and light railway undertakings. Salary £400. Applications to Mr. C. Sydney Watson, Clerk, Town Hall, Walthamstow	Dec. 10
Birmingham.—Assistant science master, King Edward School. Biologist desired. Salary £160 to £200. Applications to Mr. R. Cary Gilson, King Edward School	Dec. 31
Manchester.—Working electrical foreman with practical experience in construction and working of three-wire lighting and power, testing and repair of motors, etc. Particulars from the principal, Mr. J. H. Reynolds, Municipal School of Technology, Sackville Street, Manchester.	
Croydon.—Superintendent of fire brigade. Salary £150, with living accommodation. Mr. F. C. Lloyd, Town Clerk	Dec. 12

APPOINTMENTS FILLED.

Egypt.—Mr. Wells, late manager of the Nile Valley Company, Ltd., has been appointed by the Egyptian Government as inspector of mines at a salary of £1,400 per aunum.

Bury.—Mr. William Clough has been appointed manager of the Bury Corporation Tramways, at a salary of £250 a year. Mr. Clough has filled the position temporarily for twelve months.

L.C.C.—Professor Biles has been retained by the London County Council at a fee of £750 to supervise the construction of the hulls of the river steamers which are to be built for the Council at Glasgow and Southampton.

Dartford.—Mr. J. D. Pember, electrical engineer and tramway manager to the Farnworth Urban District Council, has been appointed electrical engineer to the Dartford Urban District Council, at a salary of £250 per annum.

Ledbury.—Mr. R. G. Gurney has been appointed surveyor, inspector, and waterworks engineer to the District Council, at a salary of £300 per annum.

Leeds.—Mr. H. A. Fleet, of the Mersey Railway Co. has been appointed station superintendent of the Yorkshire Electric Power Co.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is ing currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our are List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from ssible inaccuracies

Stock Exchange Settling Days. Settling days on the Stock Exchange are as follows :—
Consols : January 5th. General Settlements : December 15th, 30th, January 13th. Bank Rate, April 21st, 3 per cent

1. -ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
11,270	5	1/6	Alldays & Onions Pneumatic Engineering, Ltd. ..	3	2½ - 3
10,000	5	3	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
80,000	Stk	4½	Do. Mort. Deb. 4½ .	100	98 —100
210,000	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3½
76,970	5	2/-	Do. 4% Cum. Pref..	5	5⅜— 5⅝
[illegible],000	100	4	Do. 4% 1st Mort. Debs. Rd	100	102 —104
100,000	100	4½	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red. . .	100	97 —100
30,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	3½ 3⅝
100,000	1	7½d.	Do. .. 6% Cum. Pref	1	1½— 1⅝
20,000	5	3	Baker (Joseph) and Sons, Ltd. 6% Cum. Pref...	5	5 — 5⅛
250,000	1	6½d.	Baldwins, Ltd., 5½% Cum. Pref. .	1	1 - 1½
250,000	Stk	4½	Do. 1st Mt. 4½ Deb. Stk. Red	100	101 —103
150,000	4½	2/-	Barrow Hæmatite Steel Co., Ld., O	4½	1[illegible] - 1[illegible]
50,000	4½	6	Do. do. Cum 2nd. Pref	4½	3[illegible]— 4¼
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares ..	5	4¾— 5¼
500,000	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd		50 — 52
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾ - 12¼
366,600	Stk	4	Do. 4% Deb. Stock, Red	100	100 —102
149,850	1	6d.	Bengal Iron and Steel Ord. .. .	1	[illegible] - 1½
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	½ [illegible]
300,000	1	6½d.	Do. 5½% Cum Pref.	1	[illegible]
300,000	Stk	4¼%	Do. 4¼%, Red. Deb. Stock,	100	96 99
629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,639,760	1	[illegible] - 1[illegible]
860,900	1	3d.	Do. Nos. 1,639,101-3,500,000	12/-	[illegible] — [illegible]
160,000	1	9d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1[illegible] 1[illegible]
590,000	1	1/-	Do. Ord., Nos. 1,160,001-1,750,000	1	1⅝ 1[illegible]
74,000	10	5/-	Do. 5% Cum. Pref. .	10	11¼— 11¾
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord.	5	7½— 8
23[illegible],500	5	2/6	Do. 5% Cum. Pref. ..	5	5⅛— 5¼
450,000	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	[illegible] 1¼
7[illegible],000	5	2/6	Do. 5% Cum. Pref	5	5⅜ — 5⅝
250,000	Stk	4	Do. 4½% 1st Mort. Db. Stk. Red	100	100 —102
[illegible]00,000	10	30/-	Consett Iron Co., Ltd., Ord..	7½	31 32
[illegible],000	1	2/6	Delta Metal, Ltd. Shares ..	1	1⅝ 2¼
[illegible]	1	[illegible]	Dorman, Long & Co., Ltd.	1	[illegible]
400,000	Stk	4	Do. 4% 1st Mort. Perp. Deb. Stk.	100	93 96
250,000	Stk	-	Do. 6%, 2nd Mort. Deb Stk, Red. Prov Crts. 60% pd.	—	56 — 58
200,000	5	3	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating.	5	3½ 3⅝
250,000	1	[illegible]	Dunlop (James) & Co., Ltd., Ord...	1	[illegible] — 1[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref.	1	[illegible]
4,721	13	12	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	8[illegible] 9[illegible]
69,754	13	12	Do. do do.	10	7⅝— 7⅞
20,250	10	8/-	Elliott's Metal, Ltd ..	8	4[illegible] 5[illegible]
5,000	10	[illegible]	Do. Cum. Pref. 5% .	10	9 — 9½
186,748	Stk	4	Do. Deb. 4%	100	95 100
25,000	10	6	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. .	10	10½ - 11
250,000	Stk	4	Do. 4% Mort. Deb. Stk. Red.	100	99 —102
126,000	3	3	Fraser & Chalmers, Ltd., Ord. ..	3	4½ 5
21,000	3	4/6	Do. 7½% Cum. Pref.	3	5½— 6
965,000	1	1	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2½ 2[illegible]
344,000	5	2/6	Do. 5% Cum. Pref. ..	5	5[illegible] 6
850,500	Stk	4	Do. 4% Irred. Mort. Deb. Stk.	100	105 107
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref.	5	2[illegible] 3
250,000	1	1	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 3½
20,000	10	4/6	Do. 4½% Cum. Pref.	10	10[illegible] 11
30,000	5	3	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 5[illegible]
408,505	1	1/6	Harvey United Steel Co., Ltd. .	1	1[illegible] - 1[illegible]
28,001	5	7	Head, Wrightson & Co., Ltd.	5	4½ - [illegible]
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord	1	[illegible] -
18,000	5	3/-	Do. 6% Cum. Pref. . .	5	4[illegible] 4[illegible]
30,000	10	8/-	Hornsby (Richard) & Sons, Ld., Ord.	8	6¼ 6[illegible]
750,000	1	10½d.	Howard & Bullough, Ltd., Ord.	1	1¼ - 1½
25,000	10	6	Do. 6% Pref. Non-Cum. ..	10	12¾ 13¼
250,000	Stk	4	Do. 4% Deb. Stk., Red after 1905	100	96 — 99
37,500	10	20	Kynoch, Ltd.	10	18 — 19
10,537	10	5%	Do. Cum. Pref. 5% .	10	10½ 11
300,000	1	4½d	Lambert Bros., Ltd., Ord.	1	[illegible]— [illegible]
50,000	5	2/9	Do. 5½% Cum. Pref	5	4 4½
10,000	3	2/1½	Leeds Forge Co, 7% Cum. Pref. ..	3	3[illegible] - 4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1[illegible] - 1[illegible]
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 110
40,000	10	5	Mather & Platt, Ld., 5% Cum. Pref	10	10¼ 11¼
210,000	1	6d.	Measures Bros., Ltd., Ord. . .	1	[illegible]
75,000	1	6¾d.	Do. 5½% Cum. Pref.	1	[illegible]
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	96 - 99
21,943	5	2/6	Muntz Metal, Ltd.	5	4½ [illegible]
14,248	5	5%	Do. Pref. 5% ..	5	4[illegible] [illegible]
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	71 — 73
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	11¾— 12
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	92 — 95
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3⅜ 3½
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾ 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord.	10	8¼ 8¾
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld, 6% Cm. P.	5	4¾— 5
230,000	1		Projectile Co. (1902), Ltd., Ord. ..	1	[illegible]
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1½ 1[illegible]
73,062	5	2/-	Do. New ..	5	1⅜ 1[illegible]
£330,000		5%	Do. 5% Mort. Deb., Red. ..	100	101 104
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	96 98
35,000	10	12/-	Ruston, Proctor & Co., Ltd. .	10	9¼ 9[illegible]
27,000	1	6d.	Scott (Walter), Ltd., Ord	1	¾ 1
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1— 1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	95 - 97
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld 1st Charge 5% Debs.. Red ..	100	91 — 94
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	92 — 97
250,000	1	1/-	South Durham Steel & Iron, Ltd Or.	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref...	1	[illegible]
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	70 — 80
25,000	10		Stephenson (Robert) & Co., Ltd., Or.	10	1½ 1[illegible]
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	3½ 4
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	75 77
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	16¾ 17¼
55,000	10	6/-	Do. 6% Cum. Pref . .	10	14 — 14½
634,732	1	4.69d.	Swan, Hunter & Wigham Richardson, Lim. Ord.	1	¾ 1
538,845	1	6d.	Do. 5% Cum. Pref.	1	[illegible] 1¼
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. St., Red.	100	98 —101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	66 — 70
£160,000	1	7½d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref	1	[illegible] 1[illegible]
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9¾ 10¼
$508495200	$100	$½	United States Steel Corp. Com. Stk	$100	[illegible]
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	96¼ 97
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	[illegible] 96
3,450,000	1	1	Vickers, Sons & Maxim, Ltd. Ord..	1	2[illegible] 2[illegible]
750,000	1	6d.	Do. 5% Non-Cum. Pref.	1	1[illegible] 1¼
£750,000	Stk	5	Do. 5% Non-Cum. Pref. Stock	100	109 112
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	103 10[illegible]
£1,000,000	100	4½	Do. 4½ 2nd Mort. Debs., Red	100	102 —104
225,000	1	1/2	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	[illegible]
500,000	1	7½d.	Do. 6% Cum. Pref. Ord. ..	1	[illegible]
£300,000	Stk	4	Do. 4% Perpetual Deb. Stock	100	8[illegible] 8[illegible]
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum Pref 5½	5	4½ - 4¾
300	Stk	4½	Do. Mort Deb. 4½ .	100	93 — 95
66,666	5	3/-	Willans & Robinson, Ord.	5	1 — 2
66,666	5	3/-	Do. 6% Cum. Pref. .	5	2 3
£246,641	Stk	4	Do. 4% 1st Mort. Deb. Stk. Red.	100	74 - 75
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red	100	80 85

Stocks and Shares marked * are quoted ex-dividend.

—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
70,000	[illegible]	6d.	Alliance Elec Co. Ltd. 5% Cum Pf.	1	[illegible]
125,000	1	7d.	Aron Elec Meter Ltd., 6% Cum Pf	1	7/16 — 9/16
120,000	1	[illegible]	Bell's Asbestos Co., Ltd.	1	[illegible]
100,000	5	4/-	British Insulated and Helsby Cables Ltd., Ord	5	[illegible]
100,000	5	3/-	Do. 6% Cum Pref	5	[illegible]
£500,000	Stk	1½	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	102 — 105
£200,000	Stk	4	British Thomson-Houston Co., Ltd. 4½% 1st Mort. Deb. Stk. Red. .	100	100 — 102
100,000	..	3	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. ..	5	2 — 3½
£616,253	Stk	4	Do. 4% Mort. Deb. Stk. Red	100	88 — 90
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord. .	2	[illegible]
150,000	2	2/4	Do. 6% Pref.	2	1¼ — 1½
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk.	100	[illegible] — 96
£[illegible]5,000	Stk	4	Do. 4½% Perp. 2nd Deb. Stk	100	69 — 73
[illegible]5,000	5	5/-	Callender's Cable & Constn. Ltd. Ord	[illegible]	9 — 10
40,000	5	2/6	Do. 5% Cum Pref.	[illegible]	[illegible]
£500,000	Stk	4½	Do. 4½% 1st Mort. Deb Stk. Red	100	104 — 106
85,000	3	1/6	Crompton & Co., Ltd...	3	1½ — 1¾
£100,000		5	Do. 5% 1st Mort. Reg. Debs	100	93 — 98
72,000	5	10/-	Dick, Kerr & Co., Ltd., Ord.	5	7½ — 7¾
61,000	5	3/-	Do. 6% Cum Pref.	5	5 — 5½
£500,000	Stk	4½	Do. 4½% Deb. Stock, Red. ..	100	104 — 106
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1¼ — 1½
£233,334	Stk	4%	Do. 1st Mort. 4% Free. Deb. Stk.	100	106 — 109
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	[illegible]
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1
£344,023	Stk	4%	Do. 4% Deb. Stock Red.	100	78 — 83
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 81
112,100	2	1/7	Electric Construction Co. Ltd. .	2	1½ — 1
31,390	2	2/9	Do. 7% Cumulative Pref. .	2	2¼ — 2
£200,000	Stk	4	Do. 4% Perp. 1st Mt. Deb. Stk.	100	98 — 100
10,248	10	7/6	Evered and Co., Ltd.	10	13 — 15
£100,000	Stk	5	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref	10	9½ — 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10½ — 11
35,000	5	2/3	Do. 4½% Cum Pref.	5	5 — 5¼
£500,000	Stk	4½	Do. 4½% Mt. Deb. Stk. Red.	100	110 — 112
50,000	10	5/-	India Rubber Gutta Percha & Telegraph Works Co., Ltd.,	10	19¼ — 19¾
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 — 102
7,500	10		Parker, Thos., Ltd.	10	6½ — 7
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	33 — 40
£150,000	100	4%	Do. 4% Deb. Bonds ..	100	103 — 105

III.—ELECTRIC TRACTION.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	7¼ — 7½
260,007	5	2/6	Do. 5% Cum Pf	5	5½ — 5¾
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888	100	143 — 146
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	10½ — 11
10,000	10	5/	Do. 5% Cum Pf. Share	10	9 — 10
£46,300	100	5%	Do. 5% Debs., Red. .	100	98 — 101
£191,325	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	91 — 96
75,6[illegible]6	1		Bath Elec. Trams, Ltd., Pf. Or.	1	[illegible] — ¾
79,394	1		Do. 5% Cum. Pf. ..	1	1 — 1¼
75,000	5		Brisbane Electric Tram Investment Co., Ltd., Ord. .. .	5	1½ — 2½
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾ — 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	96 — 100
£200,000	Stk	5%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	101 — 103
			Pref. Ord. Stock	100	102 — 105*
7,500	10	5/-	Do. 5% Cum. Perp. Pf. ..	10	10¼ — 1[illegible]
£242,800	40	4½	Do. 4½% 1st Mort. Debs. .	40	102 — 104%
£220,000	100	4½	Do. 4½% Vancouver Power Db.	100	98 — 101
133,[illegible]01	10	[illegible]	Brit. Electric Traction, Ltd., Ord.	10	[illegible] — 10¼
[illegible]	10	6/-	Do. 6% Cum. Pref. .. .	10	10½ — 11
£1,000,000	Stk	5	Do. 5% Perp. Deb. Stk.	100	117 — 119
[illegible]	Stk	4	Do. 4% 2nd Deb. Stk. Red..	100	95 — 97
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3¼ — 3¾
40,500	5	3	Do. "A" 6% Cum Pref. .	5	5½ — 5¾
[illegible]7,000	5	[illegible]	Do. "B" do.	5	[illegible]
£200,000	Stk	5	Buenos Ayres Elec. Trams Co. [illegible] Ltd., 5% Db. Stk., Red.	100	96 — 99

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up.	Closing Prices
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	97 — 100
102,268	5	3/-	Calcutta Tramways Co., Ltd.	5	[illegible]
£350,000	Stk	4½	Do. 4½% 1st Deb. Stk., Red.	100	107 — 109
480,000	1	1/-	Cape Electric Tramways, Ltd.	1	1½ — 1¾
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	4½ — [illegible]
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 — 101
155,000	5	4	City of Buenos Ayres Trams. Co., Ld.	5	10¼ — 10¾
£116,000	Stk	6	Do. Per. 6% Deb. Stk...	100	140 — 145
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 — 104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 — 14
59,987	10	6/-	Do. 6% Pref.	10	15 — 16
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3 — 4
£150,000	Stk	4	Do. 4% Deb. Stock .	100	90 — 93
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10 — 10
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	103 — 105
£[illegible]0,000	Stk		Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	103 — 105
314,016	1		Metropolitan Elec. Trams, Ltd., Def.	1	[illegible]
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	[illegible] — 1
£350,000	Stk	13/7	Do. 4½% Deb. Stock, Red.	100	103 — 105
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	[illegible]
110,923	8	2/9	North Metropolitan Tramways Co..	8	4 — 4
£150,000	100	3½	Do. 3½% Mort. Debs.	100	87 — 92
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	103 — 106
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½ — 9
£220,000	Stk	4½	Do. 4½% Deb. Stk., Red.	100	99 — 102

IV. ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares	Last Dividend.	Name	Paid up.	Closing Prices
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 — 13
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½ — 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	104 — 106
14,[illegible]00	5	[illegible]	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼ — 5¾
£50,000	Stk	1½	Do. do. 4½% 1st Deb. Stk. Red.	100	101 — 104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½ — 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼ — 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord .	5	7 — 8
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	104 — 107
70,000	5	4	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8½ — 9
10,000	5		Do. do. Ord.	5	8 — 8½
80,000	5	2/3	Do. do. 4½% Cum. Pref.	5	5½ — 5¾
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	103 — 105
40,000	5	2/3	Do. do. "City Undertaking" 4½% Cum. Pref ..	5	4[illegible] — 5
40,000	5	2/3	Do. do. do. (1903)	5	4⅞ — 5
44,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¼ — 6¾
£150,000	Stk	4½%	Do. do. 4½% Deb Stk., Red	100	109 — 111
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O	10	10½ — 11
40,000	10	6/-	Do. 6% Cum. Pref. . .	10	13½ — 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	123 — 127
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	104 — 106
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9¼ — 9¾
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 12½
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. .	100	107 — 110
£250,000	—	4½%	Do. 4½% 2nd Deb. Stk., Prv. Crts. all paid, Red	100	101 — 103
70,000	5	4/6	Edmundson's Elec. Cor. Ltd., Ord	5	6 — 6¼
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 — 6¼
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 — 108
£[illegible]50,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	88 — 93
19,000	5	2/-	Folkestone Elec. Supply Co., Ld., O	5	5½ — 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red	100	102 — 105
15,000	10		Havana Electricity Co., Ltd. . ..	10	9½ — 10½
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½ — 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100 — 102
150,000	1		Kalgoorlie Electric Power & Lighting Corp., Ltd., 6% Cum. Pref.	1	[illegible]
21,000	5	5	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12½ — 13½

Stocks and Shares marked * are quoted ex dividend.

ELECTRIC LIGHTING AND POWER.—[illegible]

[illegible]	Stk	[illegible]	[illegible]	100	102 —104
111,000	3		[illegible]	[illegible]	[illegible]
[illegible]	5	[illegible]	[illegible]		
[illegible]	Stk	[illegible]	[illegible]	100	97 — 99
[illegible]	10	[illegible]	Metropolitan Elec. Sup. Co.,Ld.,Or.	10	[illegible]
[illegible]	[illegible]	2/3	[illegible]	5	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	100	
250,000	[illegible]	[illegible]	[illegible]	[illegible]	97 — 99
[illegible]		[illegible]	[illegible] tribution Ld., 4½% 1st Mort Deb.	100	93 — 96
10,852	[illegible]	6/-	Notting Hill Elec. Ltg. Co. Ltd.Ord.	10	[illegible]
[illegible]	100	[illegible]	Do. 4% 1st Mort. Debs. ..	100	101 —103
16,500	5	[illegible]	Oxford Electric Co. Ltd., Ord.	[illegible]	6 — 6½
£59,000	Stk	[illegible]	[illegible] Red.	[illegible]	99 —101
[illegible]	[illegible]	[illegible]	[illegible] 1st Mort Deb.	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	14 — 14½
[illegible]	5	3/6	[illegible] 7% Pref.	5	8½— 9
[illegible]	Stk	[illegible]	[illegible] Deb. Stock, Red.	100	99 —101
12,000	5	[illegible]	Smithfield Markets Elec. Supply Co., Ltd. Ord.	[illegible]	[illegible]
£50,000	[illegible]	[illegible]	Do. 4% [illegible] Red.	100	83 — 87
65,000	5	3/-	South London Elec. Sup. Co.,Ltd.O.	5	[illegible]
100,000	1		[illegible] & Power Co. Ltd. Ord.	1	[illegible]
50,000	1	[illegible]	Do. 7% [illegible] Pref.	1	[illegible]
£100,000	Stk	[illegible]	Do. 4½% 1st Deb. Stock Red.	100	107 —110
[illegible]	5	[illegible]	[illegible] Supply Co., Ltd., O.	5	[illegible]
30,000	5	[illegible]	[illegible] Pref.	5	[illegible]
[illegible]	Stk	[illegible]	Do. 4% 1st Mort Deb. Stk. Red	100	104 —106
[illegible]	5	[illegible]	Westminster Elec. Supply Corp. Ltd., Ord	5	12½ — 13
28,171	5	[illegible]	Do. [illegible] Cum. Pref.	5	6½— 7

V.—TELEGRAPH & TELEPHONE COMPANIES.

£3[illegible]	100	4	African Direct Tel. Co., Ld., 4% Mt. Debs. Series A, Red.	100	[illegible] 10[illegible]
25,000	10		Amazon Telegraph Co., Ld...	[illegible]	[illegible]
£7[illegible]	Stk	[illegible]	Anglo-American Tel. Co., Ltd., Ord.	100	[illegible]
£[illegible]	Stk	[illegible]	Do. 6% Preferred Ordinary	100	[illegible]
£3,118,210	Stk	2/-	Do. Deferred Ordinary	100	[illegible]
[illegible]	5	[illegible]	[illegible] Co., Ltd.	[illegible]	[illegible]
$15,000,000	$100	[illegible]	Commercial Cable Co., Capital Stk.	$100	[illegible]
£1,903,856	[illegible]	[illegible]	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	[illegible]
16,000	10	[illegible]	Cuba Submarine Tel. Co., Ld., Ord	10	[illegible]
[illegible]	10	[illegible]	Do. 10% Preference ..	[illegible]	[illegible] 17[illegible]
6,000	[illegible]	[illegible]	Direct Spanish Telegraph Co., Ord.	5	[illegible]
			10% Cum. Preference	5	7 — [illegible]
[illegible]	50	[illegible]	Do. 4% Debs.	[illegible]	[illegible]
60,710	[illegible]		Direct U.S. Cable Co., Ltd...	[illegible]	[illegible]
[illegible]	100	4	[illegible] West [illegible] Cable Co., Ltd. [illegible] Red. Debs.	100	[illegible]
£300,000	[illegible]	[illegible]	[illegible] African, Ltd., 4% Mt. Deb.	100	[illegible]
£[illegible]	[illegible]	[illegible]	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)	[illegible]	[illegible]
300,000	10	[illegible]	[illegible]	[illegible]	[illegible]
£602,400	Stk	[illegible]	Do. 4% Mort. Deb. Stk. [illegible]	[illegible]	[illegible]
£4,000,000	Stk	[illegible]	[illegible] Co., Ltd., Ord.	[illegible]	[illegible]
£2,000,000	Stk	[illegible]	Do. 3% Pref. ..	[illegible]	[illegible]
£1,836,814	Stk	[illegible]	Do. 4% Mort. Deb. ..	[illegible]	[illegible]
[illegible]	10	5/-	[illegible] Telegraph Co., Ltd. [illegible]	10	29 — 29½
£5[illegible]700	100	[illegible]	Halifax and Bermudas Cable Co. [illegible] 4½% 1st Mort. Debs. Red.	100	101 —103
17,000	[illegible]	12/6	[illegible]	[illegible]	44 — 46
72[illegible]	1	7½d.	[illegible] Co., Ltd., O	1	
£1,963,333	Stk		[illegible] Pref.	100	107 —10[illegible]
[illegible]	Stk		Do. Deferred	100	[illegible]
15,000	[illegible]	[illegible]	Do. [illegible] 1st Pref.	10	13 — 14
15,000	10	[illegible]	Do. [illegible]	[illegible]	[illegible]
250,000	[illegible]		Do. 5% [illegible] Pref.	5	[illegible]
£2,000,000	Stk		Do. 3½% Deb. Stk., Red. ..	100	98 — 99
£689,593	Stk	[illegible]	Do. 4% [illegible]	100	104 —106
£1,000,000		[illegible]	Do. 4% [illegible] Certs., [illegible] be paid..		67½ — 68½
179,313	1	[illegible]	[illegible] Telephone & [illegible] Co., Ltd.	1	[illegible]
50,000	1	7	Do. [illegible] Cum. Pref.	1	[illegible]
£100,000	100	4	Pacific & European [illegible] Guar. Debs. Red...	100	[illegible]
11,839	8	[illegible]	Reuter's Telegram Co., Ltd.	8	[illegible]
[illegible]	[illegible]		[illegible] River Plate Telep. Co., Ltd.	5	[illegible]
40,000	5	[illegible]	Do. 5% Cum. Pref. ..	5	[illegible]
£[illegible]47	Stk		Do. 5% Deb. Stock, Red.	100	105 —107
15,609	10	6/-	[illegible] African Telegraph Co., Ltd.	10	[illegible]

TELEGRAPHS AND TELEPHONES.—*Contd.*

		Last [illegible]			
£30,0[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
150,000	[illegible]	[illegible]	[illegible]		[illegible]
88,321	10	6d.	W.India&PanamaTeleg.Co.,Ld.,Or.	[illegible]	[illegible]
[illegible]	10	6/-	Do. 6% Cum. 1st. Pref.	10	7¾— 8
4,669	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	100		[illegible]	100	103½—105½
207,930	10	5/-	Western Telegraph Co., Ltd.	[illegible]	[illegible]
[illegible]	100	[illegible]	Do. [illegible]	100	102 —104
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	101 —104

VI.—SHIPPING COMPANIES.

		[illegible] dend		[illegible] up.	
[illegible]	[illegible]	5/6	A[illegible] Ltd. [illegible]	1[illegible]	8½— 9
£[illegible]	Stk	4½%	Do. 4½% Red. 1st Mort. Deb.Stk.	100	98 —100
£672,900	Stk	[illegible]	B[illegible] Ltd., 4½% 1st Mort. Deb. Stk. Red.	[illegible]	[illegible] 95
40,000	10	[illegible]	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	[illegible] 7
£600,000	Stk	[illegible]	Do. [illegible]	100	[illegible] 78
£750,000	Stk	4½	[illegible] Line Steamers, Ltd., [illegible] Stk. Red. ..	100	[illegible] 102
[illegible]	20	10/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	[illegible]
[illegible]	20	[illegible]	Do. Nos. 60,001-100,000	1[illegible]	5¾— 6¼
£[illegible]	Stk	4½	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	99 —101
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	[illegible] 1
30,000	10	[illegible]	Do. [illegible] Pref.	10	[illegible] 10[illegible]
[illegible]	100	4½	Do. [illegible] Mort. Deb. [illegible] Red.	100	105 —107
[illegible]	7½	4/7	Gen.Steam Navigation Co., Ld.,Ord.	7½	4 — 4½
36,758	[illegible]	4/9	Do. New Cum. [illegible] Pref.	[illegible]	7 — 7[illegible]
£150,000	Stk	4	Do. 4% 1st Mort. Deb. Stk. Red.	100	96 — 98
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	[illegible]
[illegible]	5	2/9	Do. [illegible]	5	3½— 4
£200,000	Stk	4	Do. 4½% 1st Mt. Deb. Stk. Red.	100	85 — 88
141,500	10	5/-	Leyland [illegible] 5% Cum Pref. ..	10	[illegible]
£1,160,000	Stk	[illegible]	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	[illegible]
£1,160,000	Stk	7	Do. [illegible] Deferred	100	[illegible] 222
£800,000	Stk	3½%	Do. do. 3½% Deb. Stock .	[illegible]	99 —101
£[illegible]	Stk	3[illegible]	Do. [illegible] 2nd Deb. [illegible]	100	96 — 98
15,000	100	30/-	Royal Mail Steam Packet Co. Ord .	60	16 — 17
30,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	[illegible]	4 — 5½
39,075	5	2/6	Do. "B" Ord.	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¼— 8¾
24,000	10	4/6	Do. 4½% Cum. Pref...	10	[illegible] 10¼
£1,008,894	Stk	4	Do. 4% [illegible]	100	100 —102

VII.—MISCELLANEOUS COMPANIES.

60,000	1	[illegible]	Chadburn's (Ship) Tele. Ltd., Ord...	1	[illegible] 1½
£750,000	Stk	5	General Hydraulic Power Co., Ltd.	100	135 —140
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. [illegible] Cum. Pref.	10	14 — 15
183,538	1	[illegible]	Power Gas Corp., Ltd., Ord., Nos. [illegible] ..	15/-	[illegible]
65,462	1	1/-	Do. [illegible] Nos. [illegible]	1	[illegible]
135,000	1	[illegible]	Waygood (R.) & Co., Ltd., Ord. ..	1	[illegible]
135,000	1	7[illegible]	Do. 6% Cum. Pref.	1	[illegible]

RAILWAY CARRIAGE & WAGON COMPANIES.

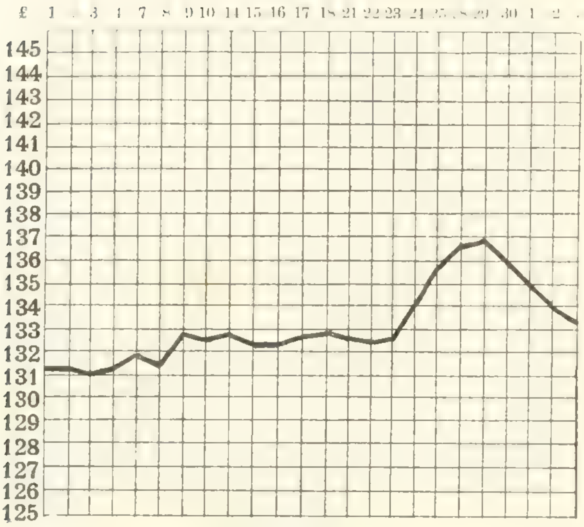
Amount Subscribed.		[illegible] dend.		[illegible] up.	Closing [illegible]
10,000	10	7/-	Birm. Railway-Car. & Wagon, L.., 1-10,000	[illegible]	21 — 21½
8,739	10	3/-	Do. Second Issue 1-8,739	[illegible]	[illegible]
[illegible]	10	6/-	Do. [illegible]	[illegible]	13 — 13½
[illegible]	7	7/-	Gloucester Rail.-Car & Wagon, Ld A, 1-[illegible]	7	[illegible]
[illegible]	7	3/6	Do. B, 29,863-49,750 50,001-75,000	7	[illegible]
7[illegible]	1	9d.	M[illegible] Carriage & Wagon [illegible]	[illegible]	[illegible]
164,288	1	[illegible]	Do. [illegible] A [illegible]	[illegible]	[illegible]
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	[illegible]
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ltd., [illegible]	[illegible]	[illegible]
10,000	20	[illegible]	Do. Pref. 6 per cent. 1-10,000	[illegible]	[illegible]

Stocks [illegible] are quoted ex-dividend.

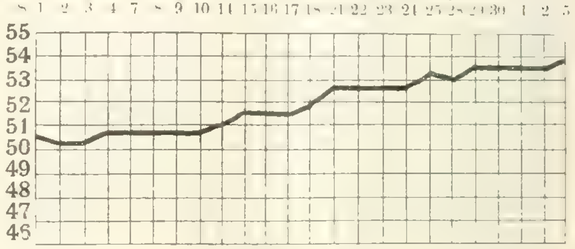
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM NOVEMBER 1st TO DECEMBER 5th.

TIN.



PIG IRON: SCOTCH,



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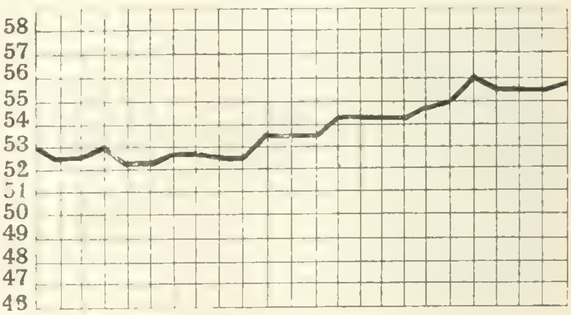
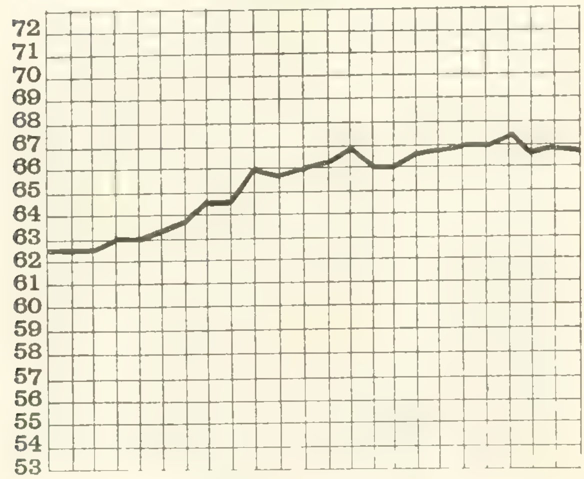
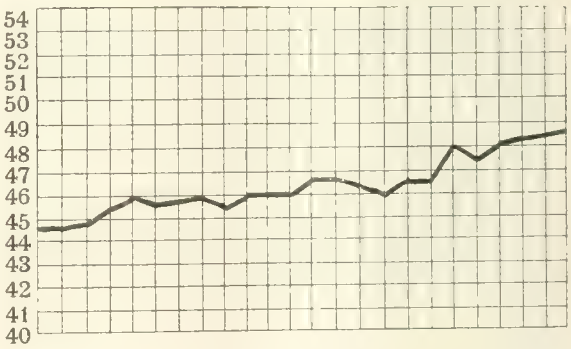


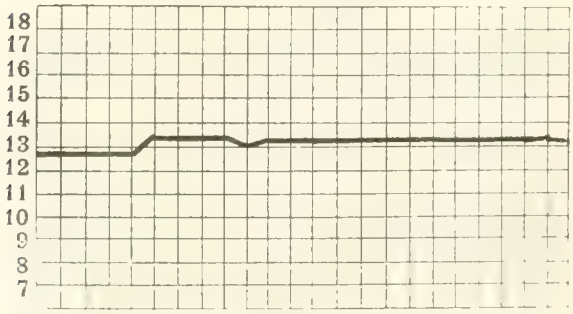
COPPER.



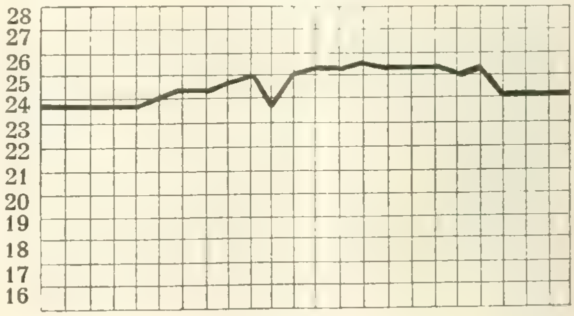
CLEVELAND.



ENGLISH LEAD.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, December 7th, 1904.

COPPER has been less active during the past week. There was a general feeling that the statistics would show an increase in the visible supply, and this suggested cautionary dealings. The latest tendency of the market is towards lower prices, but this probably is a mere phase. The present position of the metal is interesting, and as Messrs. James Lewis and Son's monthly report suggests, the pivot of the market is American consumption, which promises to increase from about 13,500 tons per month—the average of the first ten months of this year—to 20,000 tons or more. Unless, therefore, European consumption can be diminished one-third, a further material ultimate advance in values appears probable.

Tin has been a very lively market, and a large business has been transacted. There was a rush of orders consequent on the excellent results of the November Banca sale, but the publication of the statistics caused a reaction. The figures showed an increase for the month of 1793 tons, but seeing that these include the tin sold at the last Banca auction they cannot, as Merton and Co.'s circular properly points out, be fairly regarded as unfavourable. On balance, however, the market is lower.

In the iron and steel market a large business has been transacted, and prices have advanced notwithstanding the profit-taking which has been in evidence. The situation in the States looks as good as ever, and reports concerning the home trade are more favourable.

Spelter is steady, manufacturers having apparently covered their requirements for the moment. There has been an attempt to depress prices by forward speculative selling, but the position of the metal remains unchanged, and with an improving demand from South America and Australia, prices appear certain to go higher.

Lead has been dull; antimony is practically unchanged; quicksilver is quoted at £7 15s.

The coal market looks good, the general situation being very satisfactory compared with that prevailing a few weeks ago.

Timber shows a better tendency, and the statistical position is all in favour of holders of heavy stocks.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal.—

	£	s.	d.
Steel:			
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land	6	17	6
,, ,, ,, Ship Quality Plates	5	15	0
Siemens' Steel Bars, Boiler Quality	6	15	0
,, ,, ,, Ship ,,	6	5	0
,, ,, Angles	5	5	0
Manufactured Iron:			
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow ♔ Steel)	5	5	0	per ton.
Steel Ship Plates (Glasgow ♔ Steel)	5	15	0	,,
Steel Bars, Ship Quality (Glasgow ♔ Steel)	6	5	0	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	15	0	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	5	0	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	5	0	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes:—

	£	s.	d.
Bars—Phœnix	6	0	0
Best	6	10	0
Best Best	7	0	0
Extra Best	7	10	0
Best Horse Shoe	6	10	0
Extra B.H.S.	7	10	0
Extra Best Cable	8	0	0
Rivet	6	0	0
Best Scrap Rivet	7	0	0

	£	s.	d.
Angles Phœnix	6	0	0
,, Best	6	10	0
,, Extra Best	7	0	0
Gas Tube Hoops—Phœnix Best	6	10	0
Plates—Phœnix			
,, Best Boiler	7	5	0
,, Best Best Boiler	7	15	0
,, Extra Best Boiler	8	15	0
Boiler Tube Strips Phœnix Best Best	7	15	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote (Commission extra).

Pig Iron:	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	4	0	2	14	6
Gartsherrie ,,	2	18	6	2	14	0
Summerlee ,,	2	18	6	2	13	6
Carnbroe ,,	2	14	6	2	11	6
Langloan ,,	3	4	0	2	14	0
Calder ,,	2	18	6	2	13	6
Clyde ,,	2	18	0	2	13	6
Glengarnock, f.o.b. Ardrossan	2	18	0	2	12	6
Eglinton ,, ,,	2	13	6	2	11	0
Dalmellington, ,, Ayr	2	14	0	2	11	0
Shotts ,, Leith	2	18	6	2	13	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. ♛ Bars	6	7	6
W.W. Best Bars	6	17	6
W.W. Best Best	7	7	6
W.W. Best Best Best	7	17	6
W.W. Best Shoe	6	17	6
Thornaby ♛	7	17	6
Thornaby Best	8	7	6
Thornaby Best Best	9	7	6
Whitwell Special Admiralty Cable	10	0	0
Special Chain Iron	9	0	0
Tube and Nail Strips	6	10	0
W.W. ♛ Angle Iron	6	10	0
W.W. Best Angle Iron	7	0	0
Tee Iron, to 8-inches United	7	7	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron.			Steel.		
	£	s.	d.	£	s.	d.
Crown (BNF) Bars	6	10	0	7	0	0
,, ,, Angles	7	0	0	7	10	0
,, ,, Tees	7	10	0	8	0	0
(WIW) Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
Black Sheets:	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in per ton.		
Tinned Sheets:	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	10	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	5	0	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	10	0	per ton.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 2 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/3 per cwt.
Under 2 tons 9/6 per cwt. } d/d any Railway Station.

Steel cut nails, 3 inch basis
2 tons 8/- per cwt
Under 2 tons 8/3 per cwt } d d any Railway Station
Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 3, Love Lane, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote

	Per Box f.o.b. Wales. £ s. d.
Coke Tin-plates.	
C 18 by 14 124s. 110 lb "BV"	0 13 0
C 20 by 14 225s. 155 ,, "Jumbo"	0 18 3
C 20 by 14 112s. 108 ,, "Lydbrook"	0 12 6
C 28 by 20 112s. 216 ,, "Lydbrook"	1 5 3
Charcoal Tinplates:	
C 20 by 14 112s. 108 lb "Allaway"	0 13 3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

	£ s. d.	
Steel:		
Blooms	at 3 11 0	per ton.
Billets	at 3 13 0	..
Sheet Bars	at 3 15 0	..
Finished Steel:		
Bars	at 4 14 6	per ton.
Angles	at 4 15 6	..
Tees	at 4 19 0	..
Joists	at 4 7 6	,,
Fencing Standards	at 4 18 6	,,
Shoeing Bars	at 5 2 0	,,
Tyre Bars	at 5 4 0	..
Half-Round Bars	at 5 2 6	..
Heavy Rails	at 4 0 0	..
Light Rails	at 4 16 0	..

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£ s. d.	
Crown Bars	6 10 0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7 0 0	..
Angles	6 15 0	..
,, Best	7 5 0	,,
T's	7 0 0	..
,, Best	7 10 0	..
Best Shoe Iron	8 0 0	..
,, Rivet Iron	8 0 0	..
,, Best Rivet (Special)	9 5 0	..
,, Crude	9 5 0	..
,, Screwing	8 5 0	,,
,, Turning	8 0 0	..
,, Plating	8 5 0	..
,, ,, Best Best	9 5 0	..
,, ,, Treble	10 5 0	..

Channels to 5 by 2¾ in. from 7½ to 9¼ in. wide from 10 to 12 in. wide; according to specification.
Girders, 5½ by 2 in.
,, from 8½ by 3 to 9 by 5 in., and 3 by 4.
,, 10, 10½, and 12 in. high, according to specification.

	£ s. d.	
Plates	7 10 0	per ton.
Best Plates	8 0 0	..
,, Boiler Plates	8 10 0	..
,, Best Boiler Plates	9 10 0	..
Treble Best Boiler Plates	12 0 0	..

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

	£ s. d.		£ s. d.	
Tin:				
English f.o.b. Ingots...... Dis. 1¼%	134 10 0	to	135 0 0	per ton.
London or Liverpool Bars —4 cwt Barrels...... Dis. 1¼%	135 10 0	to	136 0 0	..
Straits Warehouse net cash	134 0 0	to	134 5 0	..
London 3 months fixed	133 0 0	to	133 5 0	..
Warehouse, London Australian net cash	134 0 0	to	134 15 0	..
Banca ,, ,, ...	135 0 0	to	135 10 0	
Billiton ,, ,, ...	135 10 0	to	136 0 0	..

COPPER.

	£ s. d.		£ s. d.	
Copper:				
Ore	0 11 9	to	0 12 9	per unit.
Regulus, Matte and Precipitate	0 13 0	to	0 13 6	..
Chili Bars G.M.B. Cash 2½%	66 10 0	to	66 12 6	per ton
Swansea, Liverpool, or London 3 months fixed	66 17 6	to	67 0 0	..
Australian in Warehouse, London, P. C. C. Burra Cake, Wallaroo Cake.. ...	Nominal.			
Other Brands 2½%	68 10 0	to	70 0 0	..
English f.o.b.				
Tough Cake 2½%	70 0 0	to	70 10 0	..
,, Ingot	70 0 0	to	70 10 0	
Best Selected 2½%	70 10 0	to	71 0 0	..
Sheets, Sheathing and Rods 2½%	81 0 0	to	81 10 0	..
Sheets, 4 by 4 feet for India 2½%	77 0 0	to	78 0 0	..
Electro, Net	69 10 0	to	70 0 0	..

YELLOW METAL.

	£ s. d.	£ s. d.	
Yellow Metal:			
Sheets, 4 by 4 feet for India 2½%	0 0 6¾	—	lb.
f.o.b. Sheathing 2½%	0 0 6⅝	—	..

SPELTER.

	£ s. d.		£ s. d.	
Silesian, Net cash at outports	25 0 0	to	25 10 0	per ton.
Special Silesian, at outports	25 10 0	to	26 0 0	..
British, Net cash at London	25 0 0	to	26 0 0	..
Blende of 50%	6 6 6			..
Calamine	6 10 0			..

LEAD.

	£ s. d.		£ s. d.	
English Pig, 2½%, at works, London, Liverpool or Swansea	13 0 0	to	13 2 6	per ton.
Spanish, 2½% ... ex ship, Bristol, Liverpool, Newcastle, Swansea, etc.	12 17 6	to	12 18 9	..
Lead Ore of 70%	6 15 0			..

ANTIMONY.

	£ s. d.		£ s. d.	
Star Regulus	38 0 0	to	39 0 0	per ton.
Ore (50% good quality and produce)	9 0 0	to		..
Crude	14 0 0	to	14 10 0	..

QUICKSILVER.

	£ s. d.
Spanish, per flask containing 75 lb	7 15 0
Italian	7 14 0

COAL,

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage:—

Upper Main Seam.

	s.	d.
Main Coal	8	0
Best Hard Steam (hand picked, as used by the Railway Companies)	7	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	6
Fine Slack	1	0

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:

	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3¼)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:

	s.	d.
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1″ to 2″)	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best Selected Tupton Brights	9	0
Best Treble Screened Cobbles	7	9
Best Cobbles	7	3
Best Picked Hards	8	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

Steam	s	d
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

High Hazel.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, [illegible] to 2 in cube	5	6

Steam – Top Hard.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2½	per lb.
Picric, Crystals	0	0	11	,,
Tartaric at Manchester	0	0	11	,,

	£	s.	d	
Acetate of Lime: Brown at Manchester net	8	10	0	per ton.
Grey ,,	11	10	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	23	10	0	per ton.
Sal-ammoniac, Lump, 1sts, del$^{d.}$ U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate f.o.b. Liverpool	13	0	0	,,
Arsenic: Best White Powdered net	12	5	0	,,
Bleaching Powder, 35% ,,	4	2	6	,,
Borax: British Refined Crystal ,,	12	0	0	,,

Coal Tar Products:

	£	s.	d.	
Benzole, 50 90% ,,	0	0	8	per gal.
,, 90% ,,	0	0	10½	,,
Carbolic Acid Crystals, 34 35° C. ,,	0	0	6¾	per lb.
,, ,, ,, 39/40° C. ,,	0	0	7	,,
,, ,, Liquid, 97/99% ,,	0	0	9	per gal
,, ,, Crude, 62½%, at 60 F. f.o.b. ,,	0	2	3	,,
Creosote, ordinary good liquid ,,	0	0	1¼	,,
Naphtha, Crude, 20% at 120° C. ,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	0	8½	,,
,, 95% at 160° C. ,, ,,	0	0	9½	,,
,, 90% at 190° C. ,, ,,	0	0	10½	,,
,, Rectified, flash point over 73° F. f.o.b. ,,	0	0	10½	,,
,, Rectified, flash point over 100 F. f.o.b. ,,	0	0	11	,,
Naphthalene, all qualities.				
Pitch f.a.s. Manchester. ,,	1	13	0	per ton.
Copperas: Green, in bulk ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	2	0	0	,,
Cake ,,	1	2	6	,,
Copper: Sulphate	22	10	0	,,
Cyanides: 98% minimum f.o.b. net	0	0	7½	per lb.
Lead: Acetate (Sugar) White, English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	24	10	0	,,
,, ,, Grey	21	0	0	,,
,, ,, Brown at Manchester	16	10	0	,,
Nitrate	23	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent	0	2	7	,,
Potash: Bichromate... delivered England	0	0	3	per lb.
Carbonate, 90/92% ... c.i.f Hull	18	0	0	per ton.
Caustic, 75/80% ,, ,,	20	10	0	,,
Chlorate net	0	0	3$\frac{1}{16}$	per lb.
Montreal in Store, Liverpool	35	0	0	per ton.
Prussiate, Yellow net	0	0	4$\frac{15}{16}$	per lb.

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary ... ,,	5	5	0	per ton.
,, ,, ,, Refined ,,	6	5	0	,,
,, Carbonated, 48 % ... ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ... net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % ... net	6	10	0	,,
Caustic, White, 77 % ... ,,	10	10	0	,,
,, ,, 70 % ... ,,	9	12	6	,,
,, ,, 60 % ... ,,	8	12	6	,,
,, Cream, 60 % ... ,,	8	10	0	,,
Crystals, in bags ...	3	0	0	,,
,, barrels ...	3	7	6	,,
Acetate ... c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs ...	6	15	0	,,
Bichromate...delivered England...	0	0	2¼	per lb.
Chlorate ... net	0	0	$3\frac{1}{16}$	per lb
Nitrate...ex quay Liverpool, ... ,,	10	12	6	per ton.
Phosphate ...	9	5	0	,,
Prussiate ... net	0	0	3⅝	per lb.
Silicate, Solution, 140° Tw. ...	4	10	0	per ton.
Sulphate (Glauber Salts) ...	1	12	6	,,
,, (Saltcake, 95 %) ...	1	15	0	,,
Sulphur: Recovered ...	4	15	0	,,
Roll ...	6	15	0	,,
Flowers ...	7	10	0	,,
Zinc: Sulphate ...	6	15	0	,,

MINERALS.

	£	s.	d.	
Barytes: Lump Carbonate, 90/92% ...	3	10	0	,,
Sulphate, No. 1, White ...	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/– to about 30/– per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports ...	3	7	6	,,
Manganese: Lump c.i.f. Liverpool 10½d.				per metallic unit.
Ochre: French JC ... f.o.b. Rouen, net	2	5	0	per ton.
,, JF ...	5	10	0	,,
Talc: (French Chalk) ... c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
Aniline Oil ... net	0	0	4¾	per lb.
,, **Salt** ... ,,	0	0	4½	,,
Castor Oil: French, 1st pressure, f.o.b. Marseilles less 1½% ...	20	0	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½% ...	20	7	6	,,
Cocoa Nut Oil: Ceylon, ex store Manchester ... net	31	10	0	,,
Cochin, ex store Manchester ... net	33	0	0	,,
Cotton Seed Oil: Refined at Hull, less 2½% naked ...	14	10	0	,,
Edible...at Hull, less 2½% naked ...	15	0	0	,,
Glycerine: Crude, 80% ... net	31	0	0	,,
Linseed Oil: Raw... at Hull, less 2½% naked ...	13	10	0	,,
Boiled...at Hull less 2½% naked ...	14	10	0	,,
Starch: American Pearl...at Manchester, net	9	15	0	,,
Dextrine ... ,, ,,	17	10	0	,,
Farina ... ,, ,,	15	10	0	,,
Shellac: Quiet sales TN orange, January delivery at ...	11	8	0	per cwt.
Turpentine: American ... at Liverpool	39	5	0	per ton.
Russian ... at Hull...net	20	0	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	3		0	3	3
Lower Ports Pine ...	,,	0	1	3		0	1	8
Quebec Red Pine ...	,,	0	1	6		0	1	10
Quebec Oak, 1st quality ...	,,	0	2	9		0	3	3
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash ...	,,	0	1	6		0	2	3
Elm ...	,,	0	3	0		0	3	6
Hickory ...	,,	0	2	0		0	2	6
Quebec Birch ...	,,	0	1	6		0	2	3
St. John Birch ...	,,	0	1	6		0	2	0
Birch Planks ...	,,	0	0	9		0	0	11
Spruce Spars ...	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine ...	per std.	22	10	0	to	32	10	0
2nd do. do. ...	,,	17	0	0		22	0	0
3rd do. do ...	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	10	0		6	15	0
Lower Ports Spruce ...	,,	6	0	0		6	10	0
Spruce Boards ...	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn ...	per cub. ft.	0	1	3	to	0	1	8
Sawn ...	,,	0	0	10		0	1	6
Planks, Stowage ...	,,	0	0	10		0	1	0
Boards, Prime ...	per std.	12	10	0		16	0	0
Oak Timber ...	per cub. ft.	0	1	6		0	2	6
Oak Planks ...	,,	0	1	6		0	2	1
East India Teak ...	per load	12	0	0		15	0	0
Greenheart ...	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood ...	per cub ft	0	1	9	to	0	2	3
Dantzic and Memel Fir, Crown ...	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling ...	,,	0	1	9		0	1	10
Stettin ...	,,	0	1	9		0	1	11
Swedish ...	,,	0	1	2		0	1	4
Riga Whitewood ...	,,	0	1	3		0	1	6
Norway Mining Timber ...	,,	0	0	9		0	0	10
Dantzic and Stettin, etc., Oak ...	,,	0	2	6		0	3	0
Norway Spars ...	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality ...	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality ...	,,	16	0	0		17	10	0
Red Archangel and Onega, 3rd quality ...	,,	12	10	0		15	0	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ...	,,	14	0	0		15	0	0
Gefle ...	,,	14	0	0		17	10	0
Wyburg ...	,,	12	10	0		14	0	0
Uleaborg ...	,,	12	10	0		14	10	0
Gothenburg ...	,,	14	0	0		17	10	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

24,946. W. Rummel, Manchester. Nov. 17th.—Improvements in and relating to steam turbines.

24,957. Steel, Peach and Tozer, Ltd., and M. A. H. Allott, Sheffield. Nov. 17th.—An elevating and revolving turnover gear for sectional rolling mills.

24,962. H. L. Greene, J. Zilliox, and M. H. Holmwood, London. Nov. 17th.—Improvements in boiler tube cleaners.

24,971. T. L. Bainbridge, London. Nov. 17th.—Improvements in and relating to driving mechanism.

24,974. Budapesti Malomépitészet és gépgyár, Podvinecz és Heisler and I. Bzduch, London. Nov. 17th.—Variable speed gear.

24,976. B. B. Hill, London. Nov. 17th.—Improvements in steam generators.

24,980. J. Junk, London. Nov. 17th.—Means for regulating the supply of gaseous fuel to water-heating apparatus.

24,984. G. A. Barnes, London. Nov. 17th.—Improvements in mechanism for friction clutches.

24,996. H. Duffield, London. Nov. 17th.—Power generating apparatus.

25,004. F. J. Cole, London. Nov. 17th.—Improvement in steam boiler superheaters. (Date applied for April 21st, 1904.)

25,005. T. S. James, London. Nov. 17th.—An improved transmission gear.

25,011. W. P. Thompson, Liverpool. Nov. 17th.—A method for mechanically feeding hydraulic press plate presses and apparatus therefor.

25,013. L. Crompton, Liverpool. Nov. 17th.—Improvements in pipe joints.

25,023. E. Gascard, London. Nov. 17th.—Improvements in and relating to the permanent way of railways and tramways.

25,038. H. Sparrow, Wednesbury. Nov. 18th.—Loose socket joint.

25,059. E. Summerfield, Southampton. Nov. 18th.—Improvements in or relating to screw bolts and nuts.

25,060. E. J. Perry, Birmingham. Nov. 18th.—Improvements in or relating to the manufacture of chains and in apparatus employed therefor.

25,086. G. W. Bousfield, H. M. Lane, and M. W. Robinson, London. Nov. 18th.—Improvements in coal-cutting machines.

25,087. G. W. Bousfield, H. M. Lane, and M. W. Robinson, London. Nov. 18th.—Improvements in cutter or tool carrying chains for coal-cutting and other machines of a like nature.

25,117. V. Eiselt, London. Nov. 18th.—Improvements in screw wrenches.

25,118. W. Knorn, London. Nov. 18th.—Safety device for trains.

25,149. T. Fordyce, Glasgow. Nov. 19th.—An improved governor of marine engines.

25,157. J. W. Seal, London. Nov. 19th.—Improvements in two-cycle internal combustion engines.

25,160. A. W. Bennis, Manchester. Nov. 19th.—Improvements in conveyors applicable for coke and other materials.

25,161. Sir J. W. Ottley and A. W. Brightmore, Egham. Nov. 19th.—Improvements in internal combustion engines.

25,225 G. A. Becks, London. Nov. 21st.—A waste-preventing valve for automatically governing the supply of water or other liquid.

25,229. C. Hillier and A. Hillier, Birmingham. Nov. 21st.—Improvements in or connected with the linings or interior surfaces of rotary or semi-rotary pumps.

25,237. A. H. Webber, Yarmouth. Nov. 21st.—An arrangement for stopping and reversing a propeller, or any other machinery or parts of machinery, driven by an explosive or any other motive power.

25,253. R. G. Bickerton and J. Gunnill, Goole. Nov. 21st.—Vaporiser for internal combustion engines.

25,258. Nov. 21st.—Improvements in furnaces for boilers and the like.

25,269. J. H. Corthésy and G. F. Griffin, London. Nov. 21st.—Improvements in rotary engines.

25,275. E. Dubosc, London. Nov. 21st.—An improved machine for automatically cutting bevelled-toothed wheels. (Date applied for Dec. 4th, 1903.)

25,278. Nov. 21st.—Improvements in gravity bucket conveyors.

25,313. R. Eltringham, London. Nov. 21st.—Improvements in the cylinders and pistons of steam engines in which the steam valves are controlled by link mechanism.

25,319. A. H. Crockforn, London. Nov. 21st.—Improvements in transmission gearing for heavy motor-driven road vehicles and the like.

25,352. G. L. Scott, Jun., and W. Hodgson, Manchester. Nov. 22nd.—Improvements in or connected with coal hoists used for coaling or discharging coal into ships or otherwise for elevating and discharging coal, and in hoists of a similar character used for other material.

25,361. R. P. Roy, London. Nov. 22nd.—Apparatus for indicating, recording, and regulating temperature in steam generators and the like.

25,365. W. H. Robinson, London. Nov. 22nd.—Improvements in twin-screw pumps.

25,371. C. J. Rawlinson, London. Nov. 22nd.—Improvements in and relating to various variable speed gear.

25,373. E. H. Wade and J. L. Nicholson, London. Nov. 22nd.—Boiler furnaces.

25,374. E. H. Belden, London. Nov. 22nd.—Variable speed gearings.

25,377. W. Van Pittler, London. Nov. 22nd.—Improvements in rotary pumps and engines.

25,405. A. W. Clarke, London. Nov. 22nd.—Improvements in packing rings for fluid pressure turbines, rotary engines, and the like.

25,412. H. Moller and V. O. Nordstrom, London. Nov. 22nd.—Machines for cleaning steam boilers.

25,421. E. E. Glaskin, London. Nov. 22nd.—Improvements in utilising the exhaust gases of internal combustion engines for inducing air currents for cooling purposes.

25,426. G. Schwenzer and T. Hammelrath, London. Nov. 22nd.—Improvements in pumps.

25,447. J. D. Cross, Halifax. Nov. 23rd.—Improvements in internal combustion motors or engines.

25,470. E. Buss, Glasgow. Nov. 23rd.—Improvements in the propulsion of ships.

25,490. E. C. A. Griffith, London. Nov. 23rd.—An improved carburetter for internal combustion engines.

25.503. R. H. Longbotham, London. Nov. 23rd.—Improvements in high-speed steam engines and compressed air engines.

25,507. T. G Blundell, London. Nov. 23rd.—Improvements in furnaces.

25 511. J. A. Normand, F. E. Normand, and M. E. Normand, London. Nov. 23rd.—Improvements in screw-propelled vessels. (Date applied for Jan. 10th, 1904.)

25,527. H. Koppers, London. Nov. 23rd.—Improvements in and relating to coke furnaces.

25,559. G. Little and M. C. Little, Birmingham. Nov. 24th.—Improvements in conveyors, elevators, and the like.

25,560. H. J. Emuss and J. Bird, Ipswich. Nov. 24th.—An injector for the direct return to the generating boiler of steam which has been used in any heating device.

25,574. S. F. Gaunt and W. L. Watson, London. [illegible]

25,586. E. R. Smith, London. [illegible] Improvements [illegible] (Date applied for [illegible])

25,588. J. A. Fletcher and H. Wilcox, London. [illegible]

25,603. F. L. Merritt, London. Nov. 24th.—Improve- [illegible]

25,604. J. Dring and C. F. Bourne, London. Nov. [illegible]

25,612 A. H. Wall, London. Nov. [illegible] Improvements [illegible]

25,614. C. A. Hirth, London. Nov. 24th.—Improvements [illegible]

25,615. H. Barthel and P. Modler, London. Nov. [illegible]

25,621. W. Schmidt, London. Nov. 24th.—Improvements [illegible]

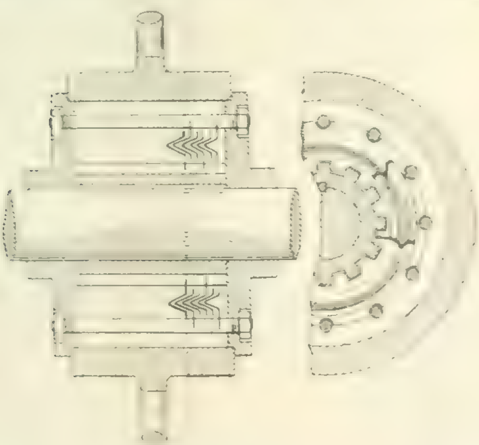
25,622. W. Schmidt, London. Nov. 24th.—Improvements [illegible]

25,627. L. K. Clark, London. Nov. 24th.—Improvements [illegible] road vehicles.

RECENT SPECIFICATIONS.

MILLWRIGHT APPLIANCES.

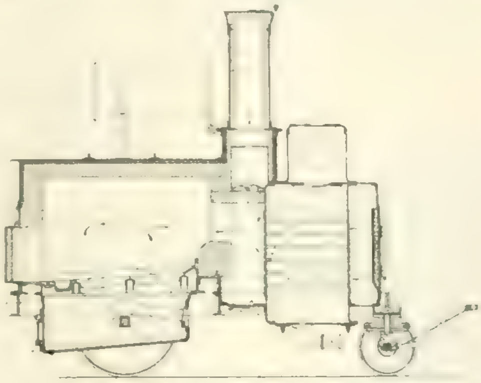
Professor Henry Selby Hele-Shaw, F.R.S., Liverpool University. Dec. 30th, 1903.—This invention relates to [illegible] dynamometers, and the like, of the type set [illegible] and No. 25,145 of 1902, and [illegible] to improve the construction of such clutches to provide for easy removal of the parts at which the wear takes place; [illegible] engaging surfaces when [illegible] corrugated, providing surfaces which are capable of slipping without continuous lubrication, or which are [illegible] and providing for



the prompt release of the engaging surfaces when the engaging [illegible] the two clutch members, and a series of detached slipper or wearing discs interposed between opposite pairs of the attached discs. These discs are identically corrugated. The wearing discs or slipper discs are corrugated to correspond with the driving and driven discs, and located, one between each pair of driver and driven discs. The slipper discs are not connected to the driver or driven parts, but are [illegible] brake, or dynamometer casing, by the engagement of the corrugations.

REFUSE DESTRUCTORS.

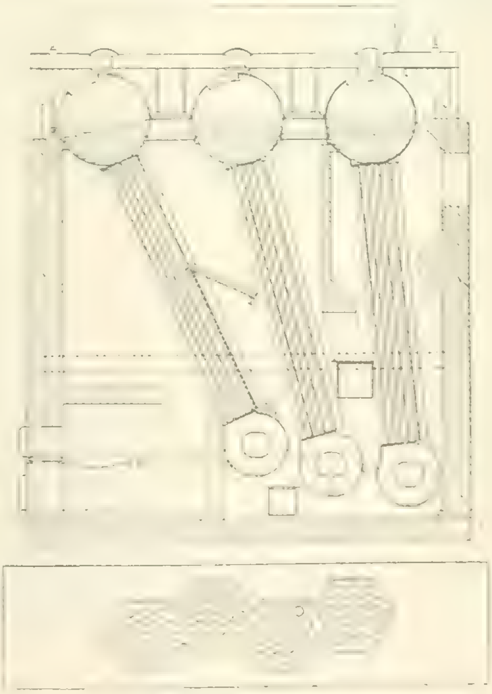
Meldrum Bros., Ltd., and J. J. Meldrum, of Manchester. [illegible] the back of the furnace, with one or some of which the furnace communicates, and each communicating with a number of the tubes [illegible]



of this destructor is that steam is so generated by the heat of the escaping gases from the furnace, which is employed to force air by means of steam jet blowers or forcing apparatus for the destruction or burning of the refuse.

STEAM GENERATORS.

Clarke, Chapman and Co., Ltd., and W. A. Woodeson, of Gateshead-on-Tyne. Dec. 24th, [illegible] This invention is a water tube boiler comprising a number of sections, each consisting of an upper or steam and water drum, and a lower or water drum with straight connecting water tubes, arranged in groups or nests, and expanded into flat portions pressed out of the walls of the drums, for instance, by hydraulic pressure. In the upper part of each upper drum and immediately over each group of tubes a manhole is arranged so that the tubes may be removed and replaced through



these manholes. Steam and water circulating pipes connect the upper drums and water circulating pipes connect the lower drums, special downcomer tubes not necessarily being employed. The lower water drum of each section, like the upper steam and water drum, is continuous for the whole width of the boiler, and is common to the [illegible]

NEW PUBLICATIONS.

"ELECTRIC SMELTING AND REFINING."

The Extraction and Treatment of Metals by Means of the Electric Current. By Dr. W. Borchers. Translated from the third German edition, with additions by Walter G. McMillan, F.I.C., F.C.S. Charles Griffin and Co., Ltd. 21s.

There is a melancholy interest associated with this scholarly work, for while the volume was passing through the press the untimely death occurred of its talented translator. It was our privilege to know Mr. Walter G. McMillan, and it is a source of real pleasure to be able to recognise in this, his last work, the fruits of his irrefutable knowledge of electricity and metallurgy, combined with literary ability of a high order, which is demonstrated on every page of the book.

The results of Dr. Borchers' many years' experience in the field of electro-metallurgy are exhaustively dealt with, and all who are engaged in scientific or technical research will find the work of incalculable assistance. Profusely illustrated, it deals with all those metals in the extraction and working of which the electric current has found any application. A short survey of the purely metallurgical methods of treating the metals has been added to each chapter, so that the reader may be in a position to compare such methods with electro-metallurgical processes, and to see how the two may be used in conjunction. In arranging the additional matter the translator has kept in view the industrial aspect of the question, and has introduced a few supplementary notes referring to actual applications of processes not otherwise referred to in the text.

We have also received: "A Handy Book of Logarithms" (Blackie and Son, Ltd.). 2s. The busy mathematician will find this a useful compilation; it comprises tables of square, roots, cubes, etc., a number of practical geometrical problems, and a set of well-printed logarithm tables, admirably arranged for reference.—"The Mechanical World Pocket Diary and Year-Book for 1895" (Emmott and Co., Ltd. 6d. net). Several new features are included in the eighteenth issue of this well-known annual, and the entire work has been thoroughly revised.—"Work," Volume XXXII. (Cassell and Co.) contains a wonderful amount of information on all handicrafts of interest to the handyman. — "Diseases of Electric Machinery" by C. Kinzbrunner, A.M.I.E.E. (Harper and Bros.) 1s. 6d. net). No advance knowledge of electric machines is assumed on the part of the reader of this little book, which was written with the object of assisting those who have charge of electric generators or motors. The matter is arranged in a tabulated form, so that it is easy to refer to the symptoms, causes, and remedies of diseases affecting electrical machinery.

BOOKS RECEIVED.

Modern Electric Practice. Edited by Magnus Maclean, M.A., D Sc. Volume V. Gresham Publishing Company. [illegible]

Quick and Easy Methods of Ascertaining the Weights of Cast-Iron and Steel. Compiled and Supplied by Alfred Laycock, 54, Petre Street Sheffield. 1s. net.

The Comparative Efficiency of English and Foreign Labour. By Lord Brassey K.C.B., D.C.L. Longmans 6d. net.

A Treatise on the Theory of Alternating Currents. By Alexander Russell, M.A., M.I.E.E. Volume I. Cambridge University Press, 12s. net.

The Practical Electrician's Pocket-Book for 1905. Edited by M. T. Crewe, M.I.Mech.E. S. Rentell and Co.

NEW CATALOGUES.

We have received from Messrs. John I. Thornycroft and Co., Ltd., a very handsome catalogue of Steam Wagons, printed on art paper, and illustrated with full page half-tone blocks. The first few pages refer to customers, honours, terms, etc., the catalogue portion being arranged as follows: Standard Four-ton Wagons, Municipal Vehicles, Five-ton Wagons, Colonial Vehicles, and List of Representatives. Amongst the illustrations, which are exceedingly interesting, is one of the first May Day Parade of Steam Wagons, 1903; a Thornycroft Steam Wagon at the Delhi Durbar, and a group of Thornycroft Wagons in Mauritius.

The British Westinghouse Electric and Manufacturing Company, Ltd.—Circular B 1071 (Revised Edition) is devoted to the Westinghouse Type "S.B." Direct-Current Motors. A number of tables are included.

The British Thomson-Houston Company, Ltd.—Pamphlet No. 176 (Superseding Pamphlet No. 156 in part) describes continuous current series multiple lamps. We have often referred to the excellent practice this firm has of punching the different sections of their catalogue ready for filing; they have now issued an index of these pamphlets.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, DEC. 9.—The Physical Society of London meets at the Royal College of Science, South Kensington, 8 p.m.—Lord Reay distributes the Awards at the Northampton Institute, 8 p.m. — Lord Belhaven distributes the prizes to the Trades Training School, Carpenters' Hall, 8 p.m.—Electro-Harmonic Society: Smoking Concert in the King's Hall, Holborn Restaurant, 8 p.m.

SATURDAY, DEC. 10.—Kings College Engineers' Dinner at the Hotel Cecil.—North of England Institute of Mining and Mechanical Engineers meet at 2 p.m. —Manchester Association of Engineers: Annual General Meeting and Election of Officers, Paper by Mr. W. H. Pretty Bedford, on "The Economic Value of Cast-Iron," Grand Hotel, 7 p.m.—Glasgow Technical College Scientific Society: Paper by Mr. John D Mackenzie A.M.I.E.E., on "Electro Metallurgy, some notes on its present position," 38, Bath Street.—University of Liverpool Engineering Society: Annual Dinner.—British Association of Waterworks Engineers: Winter Meeting, Burlington House, 11 a.m.

MONDAY, DEC. 12.—Society of Engineers: Fiftieth Annual General Meeting at the Royal United Service Institute, Whitehall, 7.30 p.m. — Society of Arts, Cantor Lecture by D. J. Blakley, 8 p.m.—Institution of Marine Engineers: Meeting at Romford Road, Stratford, 8 p.m. Paper by Mr. Lydden on "Fuel Economy in Insulation."

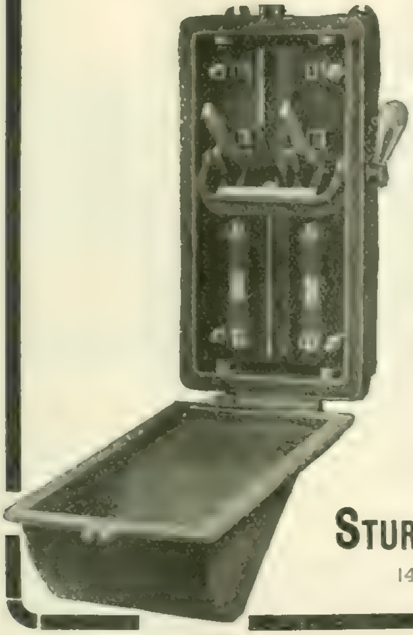
TUESDAY, DEC. 13.—Manchester Electrical Engineers: Paper by Mr. L. Andrews on "High Tension Gear." Owens College. Glasgow Electrical Engineers: Meeting at 207, Bath Street. —Meeting of the Glasgow Local Section of the Institution of Electrical Engineers.

WEDNESDAY, DEC. 14.—Institution of Civil Engineers: Ordinary Meeting at Great George Street, Westminster, 8 p.m.—The Chemical Society: Ordinary Meeting, Burlington House, Piccadilly, 5 p.m.—Society of Arts: Paper by Mr. Charles D. Abel on "The Patent Laws," 8 p.m. — Liverpool Engineering Society; Paper by Mr. T. Molyneux on "Heavy Motor Vehicles," at the Royal Institution, Liverpool. — Birmingham Electrical Engineers meet. — Society of Engineers: Fiftieth Annual Dinner.

THURSDAY, DEC. 15—Meeting of the Royal Society at Burlington House, W.—Meeting of the Institution of Mining and Metallurgy. —Birmingham Association of Mechanical Engineers: Extra Meeting, paper, Grand Hotel, 8 p. m.—Institution of Mining and Metallurgy.—Dundee Institution of Engineers: Paper by Mr. Harry Richardson, A.M.I.E.E. — Institution of Electrical Engineers: Meeting at Great George Street, 8 p.m.—Royal United Service Institute: Paper by Mr. W. Kirton.—Leeds Electrical Engineers.

FRIDAY, DEC. 16.—Institution of Mechanical Engineers: Ordinary Meeting, St. James's Park, Westminster, 8 p.m. North-East Coast Institution of Engineers and Shipbuilders: Paper by Mr. James Dickie (San Francisco) on "The Launch of the U S.A. Cruiser, *South Dakota*," Westgate Road, Newcastle-on-Tyne, 7.30 p.m.

PAGE'S WEEKLY Miscellaneous



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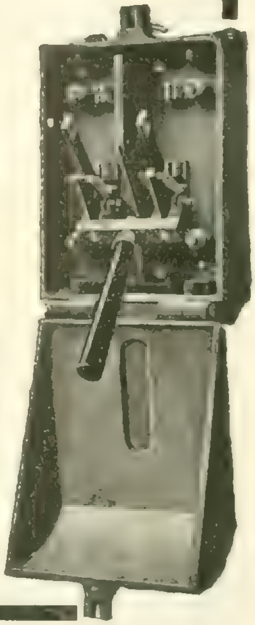

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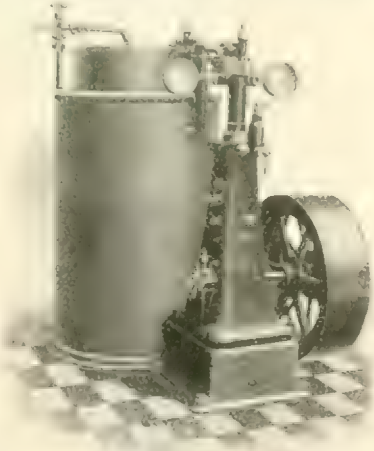

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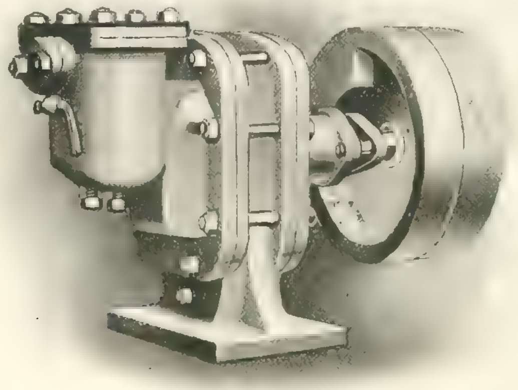

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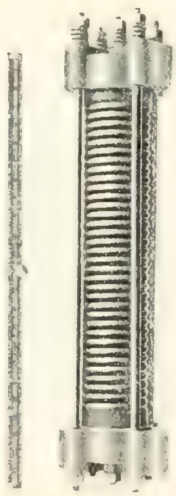

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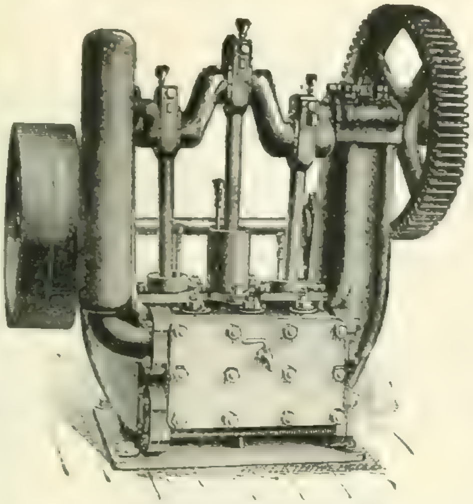

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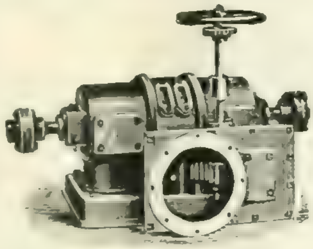

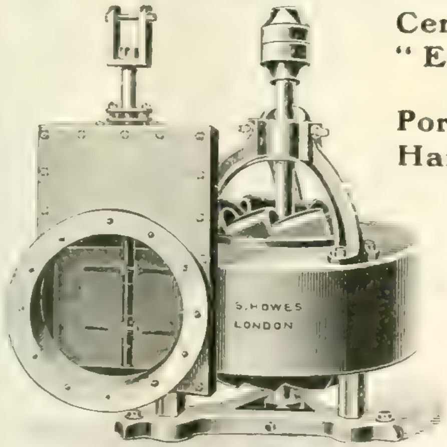

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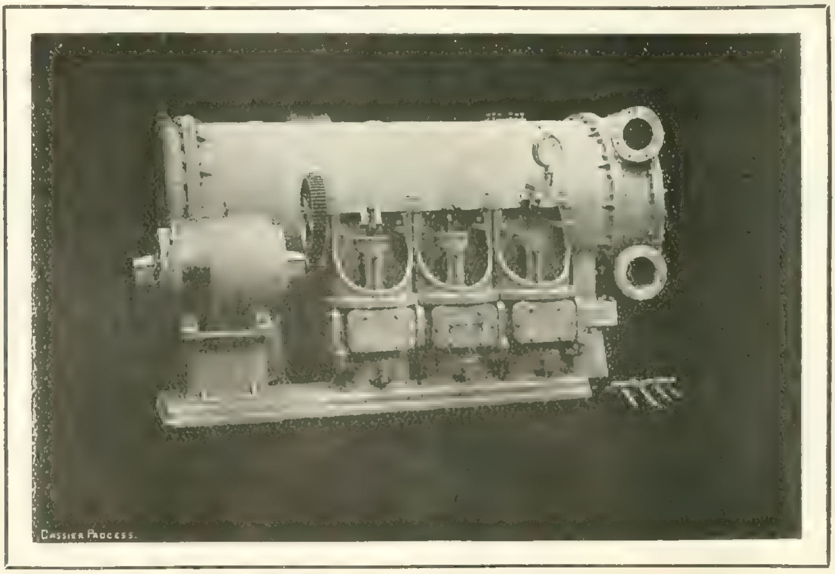

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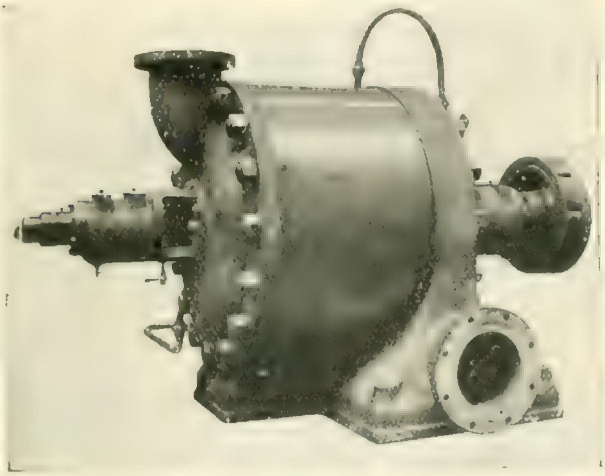

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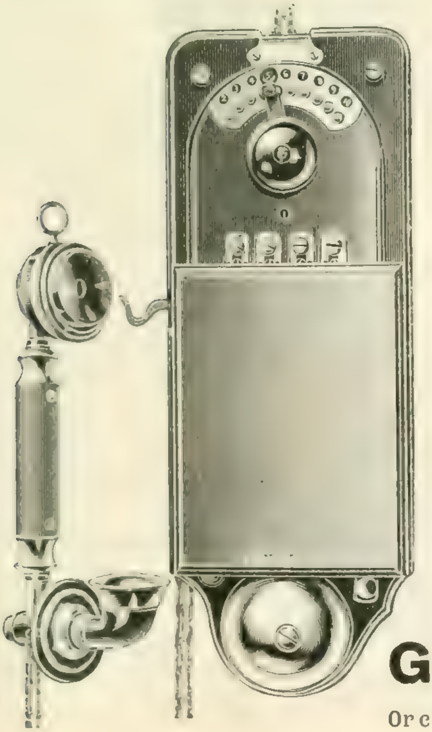

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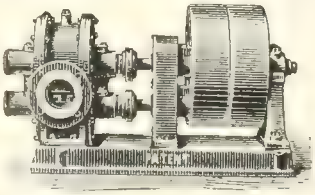

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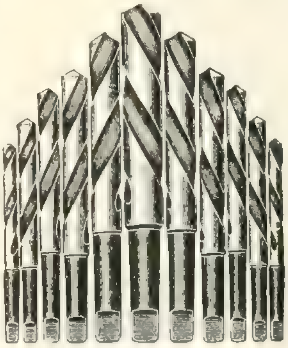

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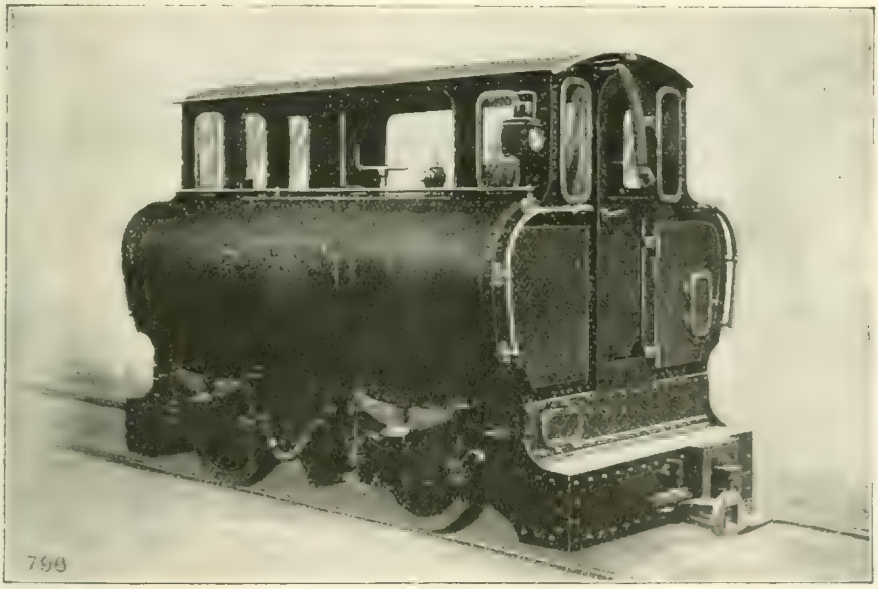

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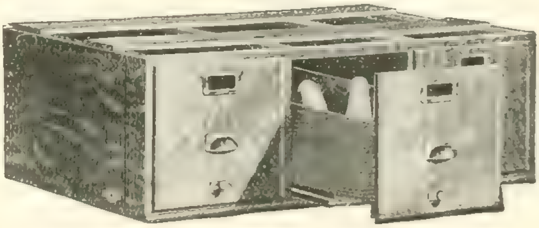

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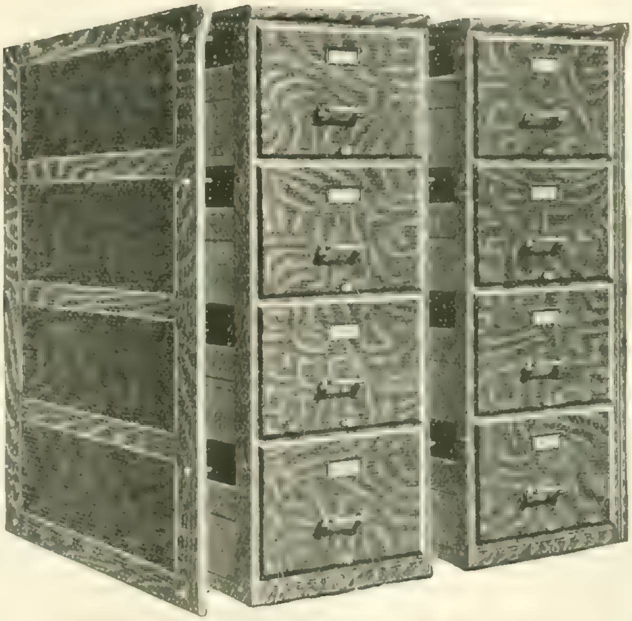
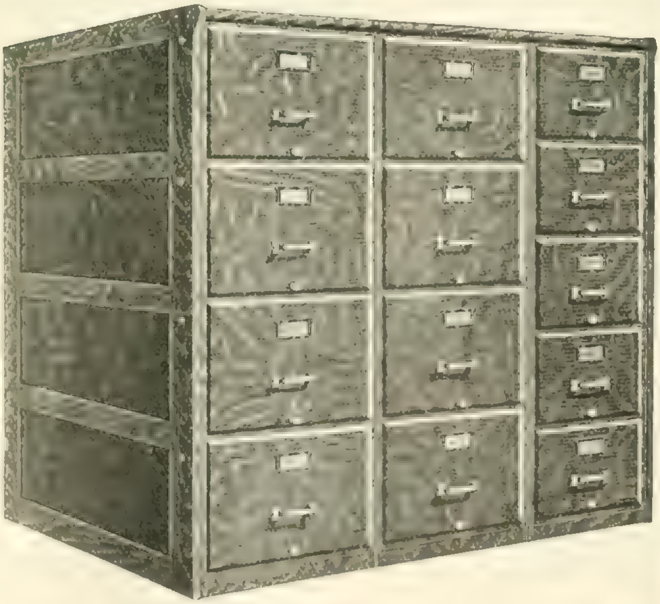


Illustrating the method of combining No. 41 Vertical File Sections, which can be extended laterally only. Either side may be removed and a new Section added when the side is replaced, the cabinet is again complete.



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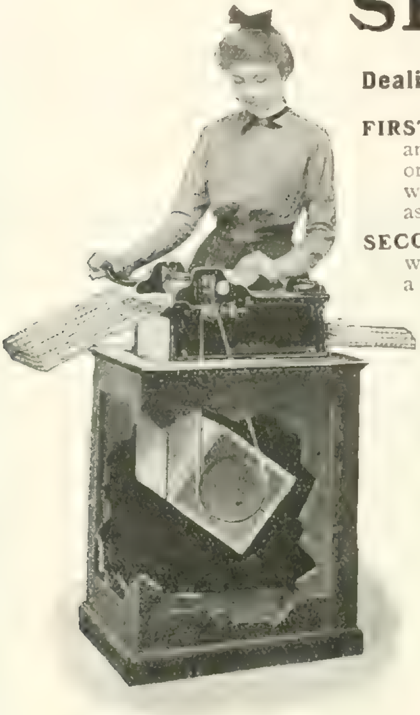

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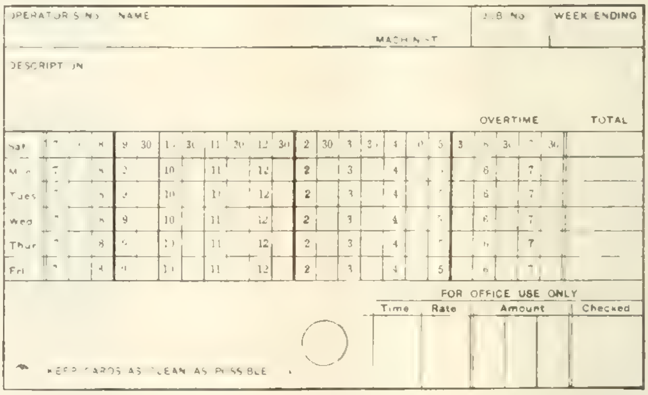

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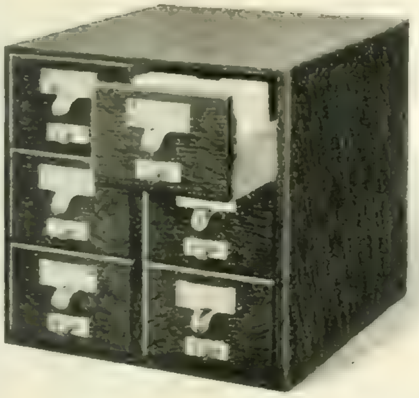

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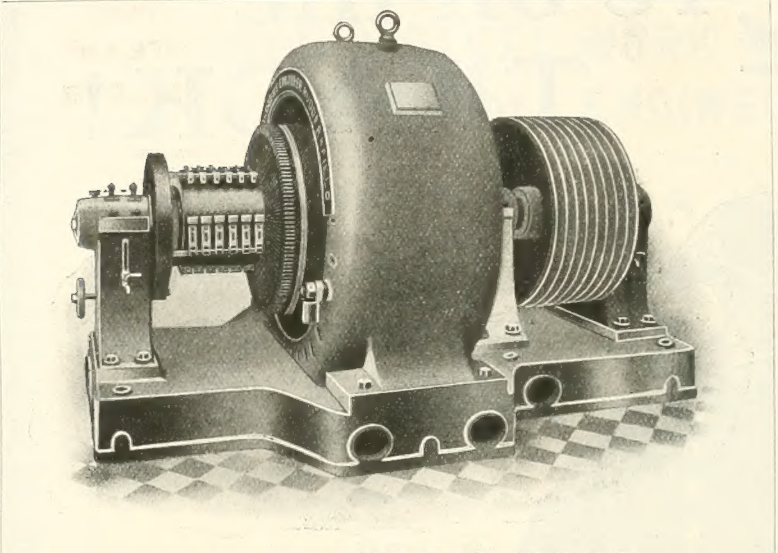

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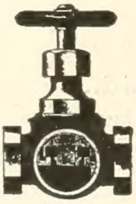

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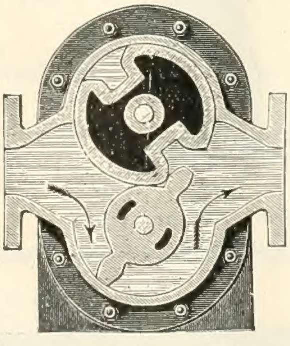

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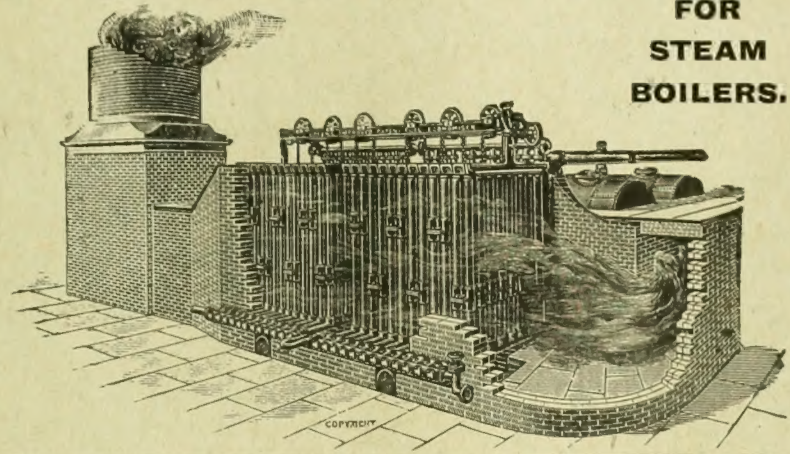

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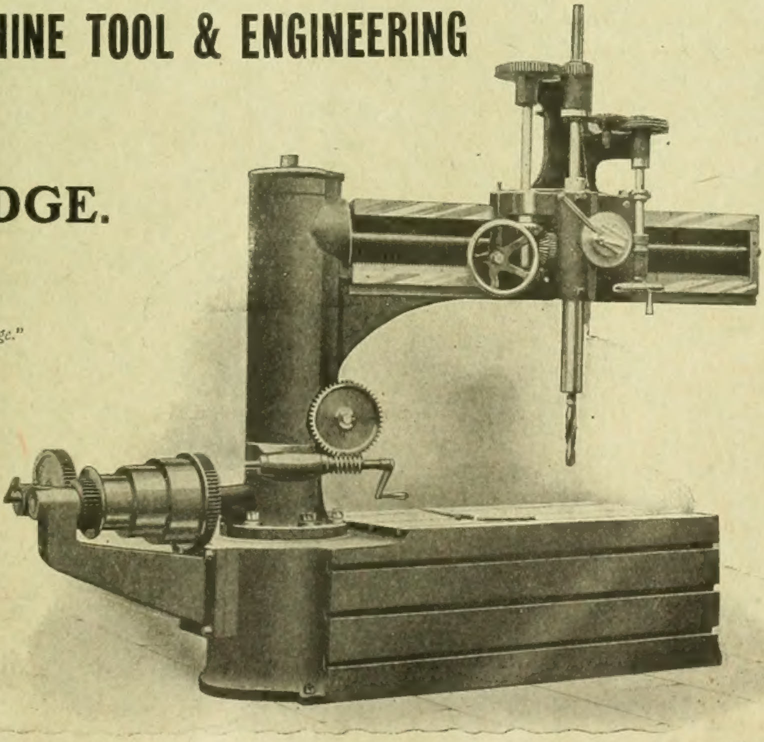

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